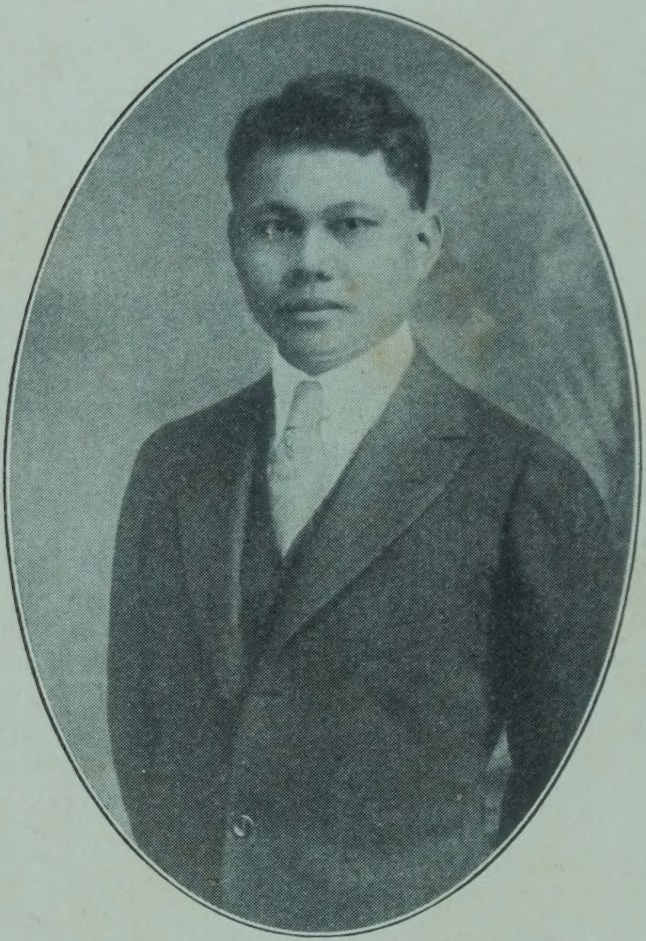

SILVERIO APOSTOL
Under Secretary of Agriculture and Natural Resources

Rice expert, recently appointed Under Secretary of Agriculture and Natural Resources. He was originally appointed Agricultural Assistant at a compensation of ₱960 per annum in 1908, and was promoted to the positions of Agricultural Inspector in 1914, Assistant Chief and Chief, Plant Industry Division, in 1916 and 1918, respectively, and Assistant Director of Agriculture in 1920. Mr. Apostol has also travelled extensively in the United States, Europe, and some of the oriental countries, to make a comparative study of the different methods of rice culture.

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ILLUSTRATIONS

BIBLIOGRAPHICAL NOTES ON PHILIPPINE AGRICULTURE, PREFACED BY A HISTORICAL SKETCH [1]

By MANUEL ARTIGAS y CUERVA, *Librarian, Philippine Library and Museum*

INTRODUCTION

The soil of the Philippines, indisputably, is the greatest asset of the country. It will bring us material prosperity, when, with the employment of modern farming methods, our fields will yield their maximum crops.

Study of the matter offers a vast field to those interested. They must familiarize themselves with all that has been written on the subject. And this is the time, with interest and activity fully awakened, to aid agriculture by giving the closest attention to everything related to increased soil production.

With this object in view, we would contribute our mite by placing at the disposal of the Bureau of Agriculture the following bibliographical notes.

It is our sincere belief that, with the praiseworthy enthusiasm now observable in matters agricultural, any work, no matter how small, along these lines, will be appreciated by those having the interests of agriculture at heart. With a desire, therefore, to serve our fellow citizens, we are giving publication to these notes.

A RETROSPECT

Agriculture, as someone aptly said, is the primitive and most important science of man—the simplest, most noble and dignified of occupations, and the foundation of all wealth. It is the mainspring of public prosperity and the most solid support of the State. Another factor which accounts for the preferential interest shown in agriculture, is its close relationship to commerce, the various products of the soil finding their way into our markets, and it is with a view of forecasting the future of Philippine agriculture that we are devoting these observations on its past and on its present.

Writers on the subject have stressed the fact that indolence and lack of education in agricultural matters are responsible for the present very unsatisfactory status of agriculture. But

[1] A free translation of an article written in Spanish which appears in its original form in the appendix of this issue.

they appear to have failed to give due consideration to whatever has actually been accomplished in stimulating soil production. If we were really as ignorant and indolent as alleged by some, it would be a grievous fault on our part. Moreover, it would lend color to the oft-repeated assertion of our lack of civilization, and to the deduction as to our capacity as a self-governing nation. As a matter of fact, many so-called civilized nations are not all some would have us believe they are.

Proof that this beautiful native soil of ours has not been lacking in productiveness to the extent alleged by some, is the fact that when Legaspi arrived at Kabalian, March 5, 1565, he found many rice and millet fields and also large areas planted to coconuts and bananas. In one of his reports to the King of Spain, that great explorer stated that the natives devoted themselves to the cultivation of the soil, in places secluded and safe from attacks by the Moros, and that the products of the land were the property of the chiefs of the barangays, who practiced the tenantry system, the actual tillers of the soil being free men and their families. There was thus, as may be seen, a fair basis upon which to build our agriculture. Padre Plasencia, in his famous report dated Nagkarlang, October 24, 1589, on the customs of the Tagalog Indians, says the following: "The lands were parceled out among the people composing the barangay, so that each of them knew his piece of land, particularly the lowland, and no one from another barangay cultivated the land unless he bought it or inherited it. In the mountain regions the land was not divided except into barangays and it happened that whenever a person belonged to a particular barangay, although he might belong to another town, the fact that he planted to rice a certain portion of the land gave him the right to the crop grown thereon. There were towns, among them Pila, Laguna, where each one of these Maharlikas paid to the datu 100 gantas of rice, but this was due to the fact that when they came to settle there, they had to buy with gold lands already occupied by others and thus it happened that the barangay people paid him this tribute and he gave the land to whom he pleased. With the arrival of the Spaniards, this practice was discontinued."

Another writer of the early period of the Spanish régime, Don Miguel Laorca, speaking of the work done in these towns, said that the tenants had seven days to cultivate their land.

This, as may be seen, was the basis of the development of our agriculture, as found by the early Spanish settlers. Moreover, the "Laws for the Indies," enacted by the mother country

which were later revised and amended in accordance with the experience gained, showed the great interest taken in Spain and here and did much to foster agriculture.

In the 17th century, following Spanish conquest of these Islands, the matter of exploiting our natural resources at once began to engross the attention of wise men. Some of the governors general showed much enthusiasm, as Basco de Vargas, who paid preferential attention to matters agricultural.

Building upon the splendid basis found when the Spaniards first came, much was done to encourage and develop agriculture. A royal edict of April 6, 1588, decreed that public lands were not to be parceled out to the prejudice of the natives. A law of June 11, 1594, vested in the State the right to possession of previous land grants, and another law, of June 11, 1612, decreed the planting to wheat of the lowland pasture lands.

It was probably with a view of correcting abuses of some of the early settlers, who, in their zeal to acquire property, had not always acted wholly within the law, that on June 30, 1616, a law was promulgated (law number 17), article 12 of which ordains that "lands which have belonged to natives or with bad title, shall not be cultivated" and directing fiscals to enforce the law.

On October 6, 1759, a royal order was issued making it obligatory upon all Filipinos to plant, every year, ten feet of ground to coconuts, cacao, bonga palm or pepper, and on February 25, 1768, another decree provided that the natives must plant a certain number of useful trees in every town, as well as wheat, rice, corn, vegetables, pepper and similar plants, and also to keep at least 12 chickens, a cock and a small pig. And, for good measure in the way of encouraging agriculture, an edict went forth at that time ordering that all rich Filipinos should own 200 feet of land planted to coconut, and another 200 planted to abaca. The poor were to plant half of this area to these two.

Another step calculated to promote agriculture was the decree of January 12, 1777, enjoining the natives to dedicate themselves to the cultivation and manufacture of flax and cannabis, which were exempted from export duties to Spain.

But it was not until after the arrival of Governor José Basco y Vargas, in July, 1778, that agriculture was given an impetus heretofore undreamed of. Governor Basco was a young man noted for culture and energy. On September 1, 1779, he made a public pronouncement in the course of which he said: "If agriculture and industry are the real basis of commerce, it behooves the leaders to ascertain if there exists in our country

that potential basis of its interior and foreign commerce." And, following up the principles here enunciated, he promulgated, on March 20, 1780, a set of rules governing the planting and manufacture of pepper, calling attention to the prizes offered by the "Tribunal of the Consulate."

His interest in the foundation of the "Sociedad Económica," also was in furtherance of the same plan. Its statutes make reference to the object of the society, viz.: to promote the study of agriculture and rural economics, and to provide that accurate data be compiled as to the nature of Philippine soil as well as of the crops to which it is planted, or may be planted, to the best advantage. Information, also, was to be gathered as to the seasons and methods of cultivation. The society was to give particular attention to pest-control measures so that with the eradication of plant diseases agriculture might flourish and a stimulus be given to increased cultivation of wheat, rice, cacao, tobacco, mulberry trees, cinnamon, pepper, clove, indigo, bonga, coconut and other plants.

Governor Basco y Vargas labored unceasingly for the agricultural development of the Philippines. He succeeded in greatly increasing production by offering, in 1783, various cash prizes to those harvesting an extra large crop of pepper and cotton, and also to those producing indigo plants equalling the product of Guatemala. On March 20, 1781, he issued a proclamation, at Arayat, urging the natives to devote themselves to the cultivation of the soil.

In the succeeding years, from 1785 to the close of the 18th century, there were promulgated laws and regulations calculated to increase soil production. There were, for instance, the instructions relative to the planting of mulberry trees and the breeding of silk worms, offering to all who cared, a number of trees and worms. The expenses of two men from each township going to Manila for instruction in the methods of cultivation were paid out of public funds. There were also instructions as to converting cinnamon and nutmeg plants into the commercial product, and still other decrees exempting Philippine products exported to Acapulco from the payment of customs duties.

Agricultural legislation from 1588 up to the close of the 18th century was largely instrumental in laying the foundation of the progressive development of Philippine agriculture.

No Spanish chief executive showed more devotion to the cause of Philippine agriculture than Governor Basco y Vargas. To stimulate agriculture, indeed, was the watchword of his gov-

ernmental policy and the history of the progress of Philippine agriculture is indissolubly linked with the name of that distinguished colonial administrator.

Governor Basco's enthusiasm, shown by aiding in the foundation of the "Sociedad Económica" in 1781, never flagged. He at all times endeavored to help agriculture, and his intimate knowledge of the subject proved a valuable aid to his zeal in carrying out his plans. China, as was generally known, since time immemorial, produced silk, the lead in this industry being taken later on by India and Persia. In these countries, production ceased for some centuries. Rome, then, became the chief silk-producing country, in the period of the Luculli and Pompeii, but for a long time prices remained prohibitive and it did not come into more general use as an article of wearing apparel until Emperor Heliogabalus set the fashion of wearing silk dresses.

Knowing the commercial value of silk, Governor Basco, soon after his arrival in the Islands, in 1781, instructed Father Galaiano, an Augustinian priest, to purchase mulberry trees, which were growing profusely on the San José College grounds. They gave silk superior in quality to the European variety.

Silk worm culture was taken up with enthusiasm by the people of Manila. The worms bred well, producing silk all the year around. Not infrequently, nine crops annually were produced, with prospects of still further increase with greater care begotten by advancing experience. The planting of mulberry trees became universal. Besides on the San José College grounds, they were grown in many other places. In Parañaque alone, 2,750 feet of ground were planted to white mulberry trees. In 1821, Samuel Perrotel began the exportation of silk to Europe.

Unfortunately, due to the lack of laborers, as asserted by some, or possibly owing to other causes, silk worm culture was later abandoned, but evidently not until about the middle of the 19th century. The publication of books on the subject by José Echegaray, Francisco Monfort and J. M. Rosi, as late as between 1841 and 1843, shows that it was not until then that silk worm culture was given up in the Islands.

Taking up again the subject of accomplishments beneficial to agriculture during the 18th century, mention should be made of the law promulgated by Governor Basco on October 29, 1782, relative to the purchase and sale of carabao. Governor Basco then said: "Agriculture has suffered much through the stealing and deaths of carabao, the only animal a farmer may use in the

cultivation of his land. It will sound the death knell of agriculture in the Philippines unless prompt and drastic remedy is applied. Agriculture is the mainstay and support of the country at all times, providing, as it does, the necessities of life. It is particularly important at this time, when the Government is considering giving impetus to art and industry, for which farm products must also supply the raw materials."

Reports of the fertility of Philippine soil reached foreign countries, it seems, and in July 30, 1780, a scientific commission headed by the famous naturalist Antonio Pineda arrived in Manila to study the flora and agricultural possibilities of the Islands. Pineda died here in 1792 without having been completely successful in his studies. The town of Pineda, now in Rizal Province, was named to perpetuate his memory. While Pineda failed to accomplish much, owing to his early death, the fact of the dispatch of that commission is significant in itself, showing that Philippine agriculture had begun to attract attention abroad.

That fame continued to spread. In 1793, Rafael María de Aguilar Ponce de León came to the Islands as Governor-General. He was one of the most accomplished chief executives the Islands ever had. Four months after his arrival he made a public pronouncement showing his enthusiasm in the development of agriculture, pointing out the necessity of increasing the exportation of farm products in order to make the Philippines more prosperous. The balance of trade, he said, was already in favor of the Islands, exports exceeding imports, and he looked forward with confidence to a still more favorable situation. He hoped much from intelligently directed effort of Filipinos and, by 1796, he said, he expected to see the value of agricultural products exported reach the figure of 2,500,000 pesos, with still more favorable showing in the succeeding years.

Before relating what was done for agriculture in the Philippines in the 19th century, we will state here all that was done prior to that time. Before 1626, the Recoleto priest Rodrigo de Aganduru Moriz published a manual of household remedies made from Philippine plants.

The work done in the 18th century formed the basis of accomplishment in the succeeding years. Progress was gradual. The fertility of the soil was such that proper effort could not but succeed.

At the beginning of the 19th century, Agustín Pedro Blaquier published a book, well annotated, on plants grown in the Visa-

yas, espelially in the Provinces of Cebu, Negros, Samar, and Leyte, where he had engaged in agriculture during the time he was parish priest in towns of these provinces.

In 1811, soon after the dawn of the century called the era of enlightenment, a learned citizen, Don Mariano Lagasca, in his book published at Irihuela, entitled "Amenidades Naturales de las Españas," speaks of a number of Philippine plants acclimated and grown in Spain. It thus appears that our flora, although not yet sufficiently studied, had begun to attract attention abroad.

Political turmoil such as revolutionary rumblings and propaganda for representation in the Cortes, engrossed public attention at the beginning of the 19th century. Still, agriculture was not forgotten. On December 7, 1801, a royal decree was issued relative to the development of agriculture and industry in the Islands, and, on April 22, 1804, the Government was asked to protect agriculture by declaring exempt from duties, cotton, coffee, and indigo, three products of considerable commercial value grown in this part of the world.

Cotton is an oriental plant. It has been cultivated in India since the remotest ages. Theophrastus wrote of it three centuries before Christ. It was not until the middle ages that it became known in Europe. Venice, in the 13th century used it in the weaving of clothes.

Cotton culture in the Philippines antedates the Spanish era. Magellan and his crew found the natives wearing cotton clothes made in primitive fashion.

The two species of Philippine cotton are superior not only to the product of Bombay, but probably to those of any other part of the world. In the Philippines, it is principally, but not exclusively, cultivated in the Ilocos provinces and in Batangas. Blending it with silk, piña or hemp, as is not infrequently done, makes an exceptionally fine fabric. A connoisseur who attended the 1887 exposition gave it as his opinion that our manufactured cotton goods compare most favorably with those of Malines and Belfast. At this time, the exports of Philippine cotton goods are considerable.

Cotton being recognized as an important agricultural product, every effort was bent to stimulate its cultivation. On April 23, 1836, the Government sent Pernambuco cotton seeds to Antique. Another measure of importance among those calculated to give impetus to the cotton industry was the opening of the port of Manila to foreign cotton on February 3, 1838.

When Governor Lemery became chief executive of the Islands, in 1861, he at once interested himself in cotton growing, and, on December 4 of that year, publicly recommended cotton cultivation on an extensive scale, pointing out how profitable it was. Later, on February 21, 1862, he declared free of duty the sowing, importation of seeds and implements used in the cultivation and manufacture of cotton. Medals and other prizes were offered as an incentive to those planting and harvesting the largest acreage of this crop.

Foreign writers, since the days of old, have had much to say on the subject of Philippine cotton. Among these was the general manager of the Compañía de Filipinas, Don Tomás Comyn, who, in his important book "Estado de las Islas Filipinas en 1810," published in Madrid in 1820, says that Philippine cotton is the best in the world. Later, in February 1855, José Martín Martínez, a distinguished physician, gave much prominence to cotton in his "Memoria sobre el Cultivo, Industria y Comercio del Algodón en Filipinas." In 1895, the same author dwelt on the importance of rice, in his fortnightly review entitled "La Vida Industrial en Filipinas."

Coffee (name apparently derived from Kaffa, where it was first grown), had been in cultivation only as far back as the 15th century. In the 18th century, it was found growing in Martinique, Santo Domingo, Guadalupe, Cayenne (French Guiana), Reunion Island and Jamaica. It was not introduced into Cuba until 1748, when Don Juan Antonio Gelabert first planted it in the region of Najay. Near the close of the 18th century some coffee plants were used in the tests conducted in the Botanical Gardens at Manila. Subsequently, coffee was planted in Laguna and other provinces. It was found easy of cultivation and also grew wild in the mountain regions, yielding beans of superior quality.

But it was in Batangas that coffee growing made the greatest progress. In 1808, only a few plants were grown in the orchards of that province, but Sr. Galleo Reyes, who was gobernadorcillo of Lipa from 1812 to 1825, was most successful in stimulating interest in coffee cultivation. His enthusiasm later slackened somewhat, but the interest in coffee was revived with the aid given by the "Sociedad Económica," which, in its zeal to propagate the cultivation of coffee, among other things was instrumental in having reprinted and distributed, in 1827, the pamphlet entitled "Memoria sobre el Cultivo del Café en la Isla de Cuba." When in 1832, Sr. Santiago Reyes, a son of Don

Galleo, was elected gobernadorcillo of Lipa, he continued the labors of his father and increased the area planted to coffee until it became very extensive in 1859.

A prominent native of Batangas, Sr. José Luz, was most active in popularizing coffee cultivation in the province. Seeds from his plantations were placed on exhibit at the fairs held in the province between 1867 and 1880, and he was awarded quite a few prizes.

Coffee production in Lipa increased gradually until 1899, when two-thirds of the land near that place was planted to coffee, and the price rose to 25 pesos per picul.

Coffee growing was stimulated by every means. After the regulations issued in 1780, Governor Enrile, in 1831, offered 7,000 pesos to anyone possessing an hacienda of 40,000 feet planted to good coffee, and, on July 27, 1837, an award of 1,000 pesos was made to M. Paul Gironier, a French physician who came to the Philippines in 1820. He resided in the country for 20 years, married a Filipina and wrote a number of books. On September 22, 1846, two prizes of 1,000 and 500 pesos were awarded to Don Yñigo Gonzales Azaola, for the two best coffee plantations.

A Spanish writer of note, Don Manuel Scheidugel, who was governor of Abra, planted coffee, in 1875, in the region of Galiano, Benguet, and in 1884, coffee was discovered growing wild in Nueva Vizcaya. Its cultivation was extended and it became one of the principal crops.

When it is taken into consideration that the coffee bean raised in Laguna and Tayabas was fully as good as that of Java and of Martinique, and not inferior to that of Mocha, Silan and Mindanao, Batangas and Camarines, the zeal with which our people dedicated themselves to the cultivation of coffee will occasion no surprise. Batangas and Camarines coffee was known as *caracolillo* and was considered the best of its class. It was the source of much profit to the hacenderos up to nearly the closing days of the Spanish régime in the Philippines. In those days, unfortunately, almost all the coffee plantations were destroyed by the *unus* pest. The *unus* is a weevil that produces larva of *Coleopter,* a beetle of medium size of the *Longicornius* group. Another coffee plant disease was that locally known as *dapulak,* caused by a small *hemipter.* In Batangas and Tayabas, coffee plants were rayaged by still another disease, known as *bagombon,* the larva of a nocturnal *lepidopter.* Gen-

erally, these insects breed in the cacao plants planted to protect the coffee plants, moving from the former to the latter.[1]

Coffee culture began to decline in the town of Lipa, the oldest region in which it was grown, as well as in San José and Rosario of the same province; also in Alaminos, San Pablo and Dolores, Laguna, and in Camarines, Kawit and Mindanao, in all of which places the people were largely dependent upon coffee growing for a livelihood.

The following figures may convey an idea of the extent and value of coffee produced in the Philippines.

Year	*Kilos*	*Value in pesos*
1854	852,571	145,344
1864	1,803,935	528,511
1874	2,854,270	990,574
1884	7,529,564	1,286,402
1894	503,156	177,518

As may be seen, coffee culture prospered up to 1890 and it began to revive with the arrival of the Americans, at the dawn of the 20th century, as we will see later.

The Duke of Almodóvar said that indigo was a valuable plant, but that owing to lack of care in its cultivation it yielded a product of inferior quality. But in 1779, a method of improving its cultivation patterned after that of Guatemala, was introduced.

Indigo was first cultivated on the Tambobong hacienda and later in the town of Baliwag, Bulacan, where it constituted one of the principal sources of wealth, selling generally at 90 pesos per quintal, and some of it was exported at a fair profit. People engaged in the indigo business at that time, both growers and monopolists, made good profits.

When Don José Gardoqui y Jarabeitia was appointed Governor of th Philippines, he made a tour of inspection of the entire archipelago, and on December 3, 1813, ordered the taking of a census of the tobacco planters in the district of Gapang. The report included information relative to the method employed to conserve the seed, the establishment of nurseries in the fields to be cultivated, and the care of plantations up to the time of the ripening of the tobacco—all this for the guidance of those in charge of the planting of this crop in the barrios—and also rules pertaining to improved methods of culture and curing and to the appraising of tobacco. It was suggested that the seed should be of the *pampano* (grape vines) variety, which produces

[1] Sánchez y Sánchez Domingo. "Memoria sobre un Insecto Enemigo de los Cafetos," Manila, 1890.

broad, round and thick leaves which owing to their superior quality and taste were preferred to the *Isinai* and *Minustasa* varieties. The nurseries were to be established on October 1. The transplanting was to be done on time. The distance between the plants was to be not less than two feet in order to produce good tobacco of all classes from first to sixth. The leaves were to be lopped and pruned and not to be cut until fully ripened when they were to be cured in sheds.[1]

This gave renewed impetus to agricultural matters. Our first representatives in the Spanish Cortes certainly were not unmindful of a subject which so vitally affected the well-being of our country, and so it was that our first deputy, the Ilocano Sr. Ventura de los Reyes, presented, on October 8, 1813, a bill in the Spanish Chamber providing for the development of agriculture. Later, after Philippine representation in the Cortes was suspended, Mr. Gonzales Azaola, taking advantage of the authorization to present petitions with reference to the exploitation of untilled land, asked that Chinese be permitted to come to the Islands to be employed as farm hands.

On December 2, 1814, a royal decree was issued which conferred greater freedom upon individual planters in the development of their holdings, in the general interest of agriculture and cattle raising.

On December 22, 1814, the "Real Sociedad Económica de Filipinas" was reorganized. This society, at the time of its original establishment, in the days of Basco y Vargas, as we previously pointed out, showed preferential interest in the development of our country's resources. And upon reorganization, it fulfilled the expectations that it would again dedicate its labors and energies to the promotion of agriculture in the Philippines. Governor Folgueras, a member and enthusiastic supporter of the society, on June 22, 1820, issued a memorial on agricultural conditions and later, on January 29 of the following year, was instrumental in the creation of an agricultural advisory board at Manila.

Undoubtedly, there had now been laid down a definite policy in Philippine agricultural matters, and much interest was evinced in carrying it out. On April 10, 1822, a royal decree was issued enjoining compliance with the provisions of a previous royal order, of 1821, ordaining the establishment of agricultural courses and of an acclimatization orchard, also advising

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[1] As we shall refer to tobacco again we shall describe it later.

the planting and cultivation of mulberry trees, cotton, indigo, spices, sugar cane, cinnamon and cacao, on both public and private land. It prescribed a form of reports to be rendered from time to time on the condition of agriculture and the methods that might seem best calculated to overcome obstacles to its development.

Further good intention was shown by the issuance, on November 28, 1825, of a circular calculated to arouse the zeal of the provincial officials in advancing the cultivation of the "precious crops of this country." (Quoted literally). On March 1, 1823, the "Sociedad Económica" offered to endow an island professorship of agriculture, setting aside for that purpose the sum of 250 pesos annually. Unfortunately, many difficulties were encountered in the realization of this plan and it was not consummated.

An English gentleman by the name of Dampier, who lived in Mindanao about 1668, published the first report on abaca. At the close of the second decade of the 19th century the first shipment of this valuable fiber from the Philippines was made, 41 tons of hemp going to Massachusetts, U. S. A. The "Sociedad Económica," in its studies of agricultural matters, had seen these reports, so, on October 6, 1825, it was able to coöperate with the activities that were being displayed along these lines at that time, and it rendered its first "Memoria" [1] on abaca growing. At that time, 276 tons of the fiber had already been exported, and 12 years later, on May 1, 1837, the first abaca crop was harvested in Laguna.

Some writers on this fiber dwelt on its importance. A "Brief" together with a "Memoria" which dealt with the importance of abaca, was sent to his Majesty the King of Spain.

It may not be amiss here to make reference also to a "Memoria sobre el Beneficio del Abacá a Máquina," submitted by Sr. Abelardo Cuesta to the "Sociedad Económica," and to the work of Jordana written in 1788, entitled "El Abacá." This monocotyledonous plant was also referred to in Martin Sesse's "Flora Mexicana" published in 1787. Other writers on the same subject included José Pavón, who wrote "Flora Peruana, Chilena y Filipina," in 1797, and Alexander Humboldt, in his "Geografía de las Plantas," published in 1810.

Abaca being an important product of the Islands, exportation continually increased. In 1894, exports amounted to only ₱7,262,396, but in 1903, 126,500 tons were shipped out of the

[1] Report.

country, valued at ₱21,701,575. Production and exports increased until after the end of the first decade of this century they reached the following figures:

Year	*Kilos*	*Value in pesos*
1910	163,173,211	32,950,622
1911	148,202,047	28,970,254
1912	175,137,180	44,151,344
1913	119,821,435	42,242,168
1914	116,386,575	38,389,630
1915	142,010,431	42,678,200
1916	137,326,092	53,384,593
1917	169,435,204	93,615,559

As a complement to the work along these lines, a royal order was issued on April 6, 1828, which took effect on October 22 of the following year, providing for the introduction of agricultural machinery in the Philippines. Such machinery was considered essential in the development of agriculture, as it greatly helped the farmers in their operations by not only having time but doing the work more effectively.

On the last-mentioned date, prizes were offered to farmers leading in the production of indigo and in fruit tree growing. Another prize of ₱8,000 was offered to the cultivator of a coffee plantation of at least 60,000 feet. There were also prizes of ₱6,000 and ₱4,000 for those successfully planting coffee on less acreage. Further prizes of ₱8,000 and ₱6,000 were to go to owners of cacao plantations, and successful cinnamon growers were to be rewarded with prize of ₱15,000 and ₱12,000. All laborers who had worked five years on any hacienda to the satisfaction of the owner, were to be exempted from taxation.

We now come to sugar cane, already touched on above and on the importance of which a number of writers on agricultural subjects had dwelt with a view of increasing its cultivation. Partisans of sugar cane cultivation were right. The country derived big profits from its successful cultivation, just as did other countries since the days of old, when sugar cane was first planted on this planet. Sugar was known long before the Christian era, being native to Asia, from whence it was introduced into Arabia. It was also known in ancient Persia, where it was being refined by the Arabs. In the year 999 it was introduced into Venice from Alexandria. It was not until the 12th century that sugar planting was taken up extensively in North Africa and southern Europe, where the first sugar mill was built about that time.

When the Spaniards arrived in the Philippines they found extensive areas of land planted to sugar cane [1] and Governor Sande spoke of sugar mills.[2]

The shape of the sugar "pilón" is of Chinese origin.

Sugar was first exported from the Philippines in 1835, to the amount of 11,777,000 kilos. Since then, exportations of this commodity increased steadily until they reached, in 1894, 210,646,336 kilos valued at ₱5,474,422.

The following table will convey an idea of the steady increase of sugar exports, from 1900 to 1917:

Year	*Kilos*	*Value in pesos*
1900	90,869,008	26,580,800
1901	126,245,112	31,953,280
1902	113,284,000	38,581,220
1903	139,956,032	44,001,176
1904	123,583,192	41,888,354
1905	130,437,128	43,514,688
1906	104,078,024	39,225,264
1907	117,241,320	39,378,986
1908	131,382,008	33,003,912
1909	167,953,119	33,792,000
1910	163,173,211	32,950,622
1911	148,202,047	28,970,254
1912	175,137,180	44,242,168
1913	119,821,435	42,242,168
1914	116,386,575	38,389,630
1915	142,010,431	42,678,200
1916	137,326,092	53,384,593
1917	169,435,204	93,615,559

How was cacao introduced in the Philippines? An Augustinian monk, Fr. Casimiro Diaz [3] speaking of cacao, says: "In 1670, a pilot named Pedro Bravo brought in a flower pot from Laguna, a cutting of Acapulco cacao. He gave the cutting to a brother, a curate in Camarines, known as "el bachiller Bartolomé Bravo." It was stolen from the latter by a native of Lipa named Juan del Aguila who was the first to plant it. This was the beginning of cacao cultivation in the Philippines.

Another monk, the Recoleto Fr. Juan de la Concepción [4] in re-

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[1] The report of Father Alonso Sánchez, published in 1578, says among other things: "The Philippines have plenty of honey and sugar cane."

[2] See letter of Sande of June 8, 1577, dealing with a variety of subjects. The letter may be found on stand 1, box 1 of bundle 2.24 of the Archives of the Indies, in the library of Seville.

[3] See p. 43 of "Conquista de las Islas Filipinas," Valladolid, 1860.

[4] See Vol. IX, pp——and 151 of "Historia General de Filipinas," Sampaloc, 1790.

ferring to the death of the Jesuit Father Juan Dávila, has the following to say: "The Governor D. Diego de Salcedo insisted in having some cacao cuttings brought from New Spain, for planting in the Visayas. Father Dávila succeeded in securing these cuttings in Carigara, Leyte, where the planting was begun under his personal supervision. Later it was planted in other towns and the Pintados Islands, to the great benefit of the natives and for the welfare of the Islands." And Father Blanco, in his work "Flora de Filipinas," Vol. II, p. 407, speaking of Governor Salcedo says: "Having taken possession of office in 1663, it is most probable that while he ordered cacao from America, private parties had also occasion to bring some more. So, while cacao was being propagated in Carigara, where Father Dávila was, and in other localities, the Tagalogs were likewise cultivating this plant. It is said that in 1674 Father Ignacio Mercado, the parish priest of Lipa, distributed cacao seeds to a goodly number of people there."

Buzeta and Bravo,[5] writing on the same subject, say that the seeds of cacao must be sown between November and January, in red, slightly clayey soil, which is best suited for the purpose. Before being planted the seeds are thoroughly soaked in water for several hours. The seeds are sown three meters apart under the shade of banana, if possible. Leyte, Negros, Cebu, Bohol, Samar, Misamis (Caraga), Laguna, and Pangasinan are the provinces which produce cacao more or less plentifully. Negros, Samar, and Cebu, however, lead in production. Cebu cacao is of superior quality, resembling the Caracas product. In Negros, cacao grows wild in the mountains inhabited by Igorots and Negritos. This is also of good quality, equal to that of Ternate and Manado.

Since 1850, however, when the original of this excerpt was written, things have changed and considerable cacao is now grown in the Philippines. In 1903, it did well in all parts of the archipelago, except Benguet, Lepanto Bontoc, and Siassi. The area under cultivation was 3,521 hectares.

The cinnamon is an old tree, it having been mentioned in the Bible. It seems to have originated in Ceylon and was later planted in Malabar, Sumatra, Cochin-China, Tonkin, China, Borneo, Timor, Nicobar, and Jolo. It was first introduced into the Philippines by the Compañía de Filipinas.

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[5] "Diccionario Geográfico Estadístico Histórico de las Islas Filipinas," Madrid, 1850, Vol. I, p. 29.

187000——2

While it may be said that not much was being done to develop the country in some ways, it is a fact that agriculture received considerable attention on the part of officials and individuals both in the 18th and in the 19th century.

When the Marquis of Solana, General Antonio de Urbiztondo, assumed office as Governor-General [1] he followed the example set by his predecessors, devoting much of his time to the study of agricultural matters. On August 5, 1850, he issued an executive order dividing hacenderos into two classes and authorizing the establishment of Chinese colonies with a view of developing agriculture.

Plant investigation was already being conducted by an official designated for that purpose, when wild tea and cinchona were found growing in the vicinity of Manila. In 1851, the Augustinian monk, Fr. Antonio Llanos, published a book entitled "Fragmentos de Algunas Plantas de Filipinas no Incluidas en la Flora de las Islas, de la primera y segunda edición." (Reference is made to the book of Father Blanco, previously mentioned).

The Chinese agricultural colonies established in 1850 received encouragement by the issuance of an order, on July 28, 1851, exempting from taxation for one year, all Chinese arriving in the Philippines for the first time.

Economic problems, by this time, began to crop up, causing considerable contention between capital and labor and not infrequently leading to serious disturbances. It was with a view of preventing trouble of this nature that the Government, on March 1, 1855, issued an order authorizing provincial chiefs to make cash advances to planters of tobacco, at the rate of 100 pesos per *quiñón* (one hectare is 0.3577 *quiñón* of cultivated land).

All this enthusiasm and these activities, coupled with the impetus given the growing of certain fruit trees and the wholeheartedness with which all of the planters set to work, were the main contributing causes to the general prosperity enjoyed by Philippine agriculture. And in order to make it still more profitable, free rice exportation was authorized on August 25, 1855, on condition that [2] the price of this cereal in Manila should not exceed 18 reales or 2.25 pesos (gold money was then in circulation), and 14 reales or 1.75 pesos in the provinces.

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[1] This Governor assumed office June 29, 1850, and left the service December 20, 1853.

[2] Ever since 1824 the *Sociedad Económica* had worked for free rice trade and had placed orders in the United States for rice-cleaning machinery, and on July 17, 1836, free rice trade and exportation were approved.

At this time, the ho vernment issued a royal order of April 29, 1856, ordaini following: "First. Rice and palay trade between the port provinces of the Philippine Islands shall, in the future, be ly free and not subject to any rules and formalities other those prescribed by the office of the superintendent, govern ipment and packing of other duty-free articles. Second. and palay shall be exported only through the following : Manila, in the Province of Tondo; Sual, in Pangasinan; mao, in Ilocos Norte; Salomague, in Ilocos Sur; San Migu Camarines; and also through the ports of Zamboanga, I Capiz, and Antique, in the provinces of the same name, an des through all ports having customs authorities empower handle foreign trade. Third. For rice and palay export there is no need of a special license from the Government is it necessary to observe any formalities other than thos cribed by general rules for duty-free articles."

We shall now see appened in the matter of rice production and export in ext succeeding years. Undoubtedly, production decreased when D. Fernando de Norzagaray y Escudero became Go r-General of the Islands, on March 6, 1857, one of the mo ortant problems that came up for his consideration was orbitant price of rice, owing to the failure of the crop a shortage of this cereal in China, which made it necessary to avoid difficulties that might arise due to the fact that rice staple food of the Filipinos. To meet the emergency, he lgated a decree, June 18, 1857, authorizing the importati foreign rice (cleaned) and palay until January 31 of the ing year, which term, on November 30, was extended indef , and at the same time free entry was granted.[3] Howeve s known that in 1868 large quantities of rice were export n Pangasinan to China, and from Manila to other parts of t East.

In 1875, when, a Philadelphia exposition, the Philippines exhibited their re s for the first time in an affair of this nature, a collectio 120 varieties of rice were shown by our fellow citizen the l . Regino García. The Philippine exhibit attracted universa ntion.

[3] It seems surpris at there should have been a rice shortage at this time when ther provinces, as Pampanga, for example, where four crops annuall harvested. Father Martín Zúñiga (Vol. I, p. 463) says: * "In Pampanga four crops of rice were harvested because they rown in different seasons and each was properly cultivated."

Undoubtedly, the growing of , hemp, tobacco, and other crops was more profitable than ulture and thus the latter product fell off considerably.

The economic situation, already rious problem in the days of Governor Norzagaray, again h to engross universal attention [1] and the Government co o longer remain idle. In 1879, some one in authority sai Rice, being the principal foodstuff of the Filipinos and ye f shortage of this staple being frequent, it is but natural the matter should have given rise to a great number of al measures calculated to lower its cost and to insure a suf t supply to the country. All European food legislation, old new, has been tried here, including export prohibition, a pri ing scale, appraisement, public granaries, action against us us practices of hoarders and a decree, originally issued in t ast century, prohibiting resale. Women engaged in the ric siness were admonished that they had better spent their ti n attending to their domestic duties. It was made clear tha mines and near famines (the last famines occurred in 1856 1857) would not cease in the Philippines until the State woul on record as declaring that rice traffic in the Philippines, b domestic and foreign, must be free under all circumstances.

"Since the French settled in Saigo rice production in the Philippines decreased notably, owing t e lack of demand from the Chinese market which was supplie with Cochin-China rice, more abundant and cheaper. Today, rice is exported and when the price of the most common rice aches 14 reales (1 real is about 10 centavos), foreign rice co s in to check the rise in price. The countries which yielded surplus in good years were engaged in growing sugar cane a other crops and the benefit to their people resultant theref m was evident. The pe ple who raised only rice were conside d backward and poor.

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[1] The following publications may be consulted "La Admisión Temporal de los Arroceros de la India;" Revista Filipin de Ciencias y Artes p. III. Elías de Molins José, "La Importación T nporal de los Arroceros de la India y Filipinas," Manila, 1883.

[2] See "Diccionario de la Administración del Comercio y de la Vida Práctica en Filipinas," by D. José Felipe del P n, with the coöperation of D. José de la Rosa. (Vol. I, Manila; publis d by D. Manuel Pérez, 1879, p. 111.)

"It is difficult to ascethe exact production of rice in the Islands" said a writer [1]911; only an approximate estimate can be made taking as s the cultivated area and the probable per capita consump According to semi-official reports, the area planted to ricched 2,732,572 acres. A small part of this area is irrigated wo crops are harvested yearly, and sometimes three. But arger part of the rice land depends on rains, the lateness sufficiency of which endangers the crop. The land classif suitable to rice cultivation includes a considerable portion e this crop is raised in annual rotation with other crops.

"The ordinary yield ectare is estimated at from 20 to 50 cavans. One cavan ha lbs., and a hectare is about 2½ acres. Thus, the yield was fr0 to 2,400 lbs. per acre.

"Supposing that theage yield per acre is half a ton, the total production would366,286 tons. On the other hand, if we place the daily coption per capita at ¾ of a pound, the total for eight millionbitants would be six million pounds per day, or 993,165 t year. The importation of rice last year amounted to 18 tons, showing a local production of 808,546 tons, which isa million less than the estimated yield based upon acreage. value of imported rice is about 80 pesos. The total, bason per capita consumption calculation, would thus amount tmillion pesos.

"Previous to the 1ntury, rice was one of the products of export of this count we produced at that time more than enough for home contion. With the greater attention given to the cultivation ofr, hemp and copra, rice production decreased. The formoducts, it seemed, better repaid the efforts of the farmer ice the American occupation, the falling-off of rice productioms to have increased. The fact is that more rice has been ited during the past 12 years than during any other period in istory of the Philippines.

"Although rice solds first place in production in the Islands, it does not fig the commerce as conspicuously as other products, because teater part, if not all of it, is consumed by those who produ During the past 15 years there has been a great demand fo in the regions where it is the principal dietary item, and ite has risen considerably."

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[1] See p. 773 of nacimiento Filipino," December 14, 1911.

According to customs statistics, the importation of rice from 1899 to 1917 was as follows:

Fiscal year	Tons	Value in pesos
1899	58,389	1,939,122
1900	109,910	3,113,423
1901	178,231	5,490,958
1902	216,403	6,578,481
1903	307,190	10,061,293
1904	329,925	11,548,814
1905	255,502	7,456,738
1906	138,051	4,375,500
1907	112,748	3,662,193
1908	162,174	5,861,256
1909	137,677	4,250,233
1910	184,619	5,321,962
1911	183,675	13,544,494
1912	301,057	26,017,012
1913	86,057	6,329,182
1914	96,921	6,552,296
1915	218,442	13,448,551
1916	189,836	13,043,642
1917	146,986	10,781,463

The importance of agriculture, in a country like the Philippines, is a thing that cannot be overlooked. The "Sociedad Económica" showed great interest in the matter by drafting, in 1781, its first by-laws and awarding prizes, for a number of years, to foster this source of wealth.

With similar aims in view, the Government of the Islands, pursuant to the royal decree of February 26, 1821, had planned to establish a college of agriculture, whose director was to draw a salary of 250 pesos per annum. But unfortunately the plan did not then materialize.

However, the matter of agriculture as a means to develop a fertile country, finally engrossed the attention of those who devoted their efforts to the material advancement of the Islands, and thus it was that Governor Echague strongly urged the enforcement of the provisions for the establishment of this school, in a session of the "Sociedad Económica," June 17, 1863. It was established by royal decree of May 29, 1861.

The "Sociedad Económica," in its well written report of April 13, 1869, after studying the provisions of the royal decrees of November 2, 1849, and February 6, 1867, issued in Spain, providing for agricultural education, said that the thing to do was to follow the plan of the philanthropist Felenberg, who established agricultural institutes not only to turn out good farmers, but to serve as a means of public education, to mould the character of

the people, to inculcate in them the proper use of their privileges and advantages in a manner calculated to make the rich efficiently manage their properties and give the poor a sure and honorable means of softening the hardships of life.

The "Sociedad Económica" at the same time, offered a lot of 200 *quiñones* (1 *quiñón* is 2 hectares, 79 ares and 50 centares) which was bought from its funds, and applied for a loan of 120,000 escudos (1 escudo is about 80 centavos) for the purpose of establishing an agricultural school in a penal colony.

While the carrying out of this plan was delayed by legal formalities, the Ayuntamiento, which in June, 1858, was preparing to celebrate the birthday of the Prince of Asturias, Don Alfonso, afterwards King of Spain and father of the present ruler on the throne of San Fernando, fixed the site for the school on a large tract of land on Arroceros field. The work was begun at once, with the powerful support of Governor Norzagaray, who worked hard for the welfare of the country and succeeded in securing the promulgation of the decree of September 13, 1858, which provided that the Arroceros field be set aside for the establishment of a botanical school, to conduct experiments on systems of farming and plant improvement.[1]

This was the beginning of official teaching of agriculture in the Philippines, coincident with the improvements and beautification of what is now the Botanical Gardens, one of the city's attractions.

Following our account regarding the establishment of the botanical school, we may add that the decision of the Governor of the Islands was approved by the royal decree of May 29, 1861. Eventually, the school was placed under the management of the Governor and under the direct supervision of the "Sociedad de Amigos del País." At the same time, the appropriation was approved, and it was provided that the expenses of the orchard be defrayed in the following manner: Three thousand and three pesos to be taken from the Public Treasury; ₱1,500 from the Community Bank and ₱1,500 from the funds of the "Propios y Arbitrios" of the Ayuntamiento. Revenues of the Orchard were to revert to these various funds.

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[1] According to the order of the insular authorities, it was intended to acclimatize plants which heretofore had not been properly cultivated. This was to serve as a means of instruction and study. The faculty, personnel, and equipment of this school were as follows: One professor of botany at ₱1,500; two teachers of horticulture at ₱500 each, ₱1,000; ten student laborers chosen from among the young farmers, to be changed every three years, at ₱100 each, ₱1,000; purchase of plants and implements, ₱1,500.

The decree provided that the professorship of botany and agriculture should be assigned to the director of the Orchard. Don Francisco Ramos y Borguella was appointed as the first chief of the establishment. He was suceeded by Don Felipe Zoilo Espejo y Culebra.[1] Sr. Ramos worked hard but without scientific plan, while Don Zoilo showed more ability, arranging the plants by families and publishing a primer [2] and a catalog.[3] When Don Zoilo was transferred to the central school of agriculture in Madrid where he was to take the professorship of animal husbandry the royal decree of May 17, 1876, was issued, providing that the position of director of the local botany school should be filled by the inspector of forestry, thus effecting a saving of the 3,000 pesos salary formerly paid to Don Zoilo. With this reform and others introduced on October 17, 1887, May 1 and August 12, 1878, the Botanical Gardens which was the name given the place, underwent many changes which reduced its running expenses in such a way that in 1892 only 2,600 pesos were spent for the personnel, and 1,000 pesos for materials. Through the efforts of Sr. Sainz de Baranda [4] and still more those of Don Sebastián Vidal,[5] the collection of species of native and exotic plants was materially increased. American occupation of the Islands brought other changes and the Botanical Gardens were opened to the public.

Now, speaking of the cultivation of the different species of plants in the Botanical Gardens it is only just to give due credit to the fine work accomplished along this line there. Many foreign naturalists who visited the gardens expressed their admiration of their fine condition. Their attention was particularly attracted by the great variety of medicinal plants grown there,

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[1] "El Faro Administrativo" referred to this school thus: "Origen e Historia del Botánico y de la Escuela de Agricultura" por Don Rafael García López, alcalde mayor que fué de varias provincias en aquellas islas. Madrid, published by Juan Iniesta, Hortaleza 128, Bajo, 1870.

[2] "Cartilla de Agricultura Filipina," Second edition, Manila, published by Ramírez and Firaudier, 1870.

[3] "Catalogus Seminum Horti Botanici Manilensis Anno 1876. Manila Apud Balthasarum Giraudier, MDCCCLXIX."

Other editions were printed, the last ones being issued by Sres. Salvador, Cerón, Rufino García, and Pío García.

[4] Sr. Baranda, a prominent and cultured Filipino engineer and chief of the forestry department, wrote the very interesting "Memoria sobre los Montes de Filipinas."

[5] There has been erected in the Botanical Gardens a monument in honor of that distinguished citizen. He published many valuable scientific works which brought him renown here and abroad. He died in Manila in 1890.

such as the *bagabay,* the leaves of which are used as an effective cure for rheumatism; the *lunas-lunas* vine, which is a strong antidote for certain poisons besides possessing other medicinal properties; the *eucalyptus* and the *miray,* which are used to make fine linen and innumerable other plants, all of which are of considerable therapeutic value.

Now as to tobacco, one of the most valuable sources of wealth in the Philippines, whose good quality has given it its present commercial importance. We will give a short history of this plant since its discovery.

A writer on the subject of how it first became known in Europe, says: "Tobacco, it seems, was discovered in the eastern part of the Island of Cuba, on the banks of the Caunao River, by members of Columbus' expeditionary forces, among whom were Rodrigo de Jerez, a native of Ayamonte, and Luís Torres, of Jewish origin. These men, after taking possession of the island, went inland for a distance of several leagues in search of gold. On October 12, 1492, they encountered the tobacco plant which was being used by the natives who called it *cohiva, cogiva,* or *coviva.* The discoverers, however, named it *tabaco,* a word which it is believed, resulted from the confusion created by the name of the plant and that given by the natives to a thing in the shape of a pipe which was used to draw in the smoke. At that time, it should be noted, the leaf was not smoked but burned on live coal, the smoke being inhaled through long tubes and expelled through the mouth and nostrils. It is also said that the name of tobacco has been given the plant because it was seen for the first time in Tabaco. When Christopher Columbus landed on Guanuhani Island the use of tobacco was found to be widespread among the natives. Gonzalo de Baden, in his writings of 1513, gave a detailed description of the use of the plant. In North America, the use of pipes dates back to the origin of the towns in that part of the world, as is shown by the frequent discoveries of pipes in the tombs of the earliest period."

Doctor Morales, in his valuable work published in Seville in 1574, claimed that tobacco was discovered by the Spanish priest Pane. He said that this man travelled with Columbus and that he sent the seed of the plant to Charles V.

The plant was imported into France by Juan Nicot and this is what gave it its botanical name, *Nicotiana tabacum.* However, there are others who claim that Andres Thevet, also a Frenchman, was the first to import it into France in 1556.

At this time, Bishop Nicolás Tornabona, then in France, sent tobacco to Toscana, from whence it was propagated in the course of time throughout Italy.

It seems that when Sir Walter Raleigh went to Virginia in 1583, he found the natives smoking tobacco and years later, he sent the seeds of the plant to Ireland, from whence it was introduced into Scotland and England. There are also those who claim that the British Admiral Drake brought the plant from Tabaco to England, in 1585.

The use of tobacco soon spread in the Philippines. When Magellan landed on the Island of Limasawa, Leyte, on March 28, 1521, the islanders, seeing him and his men smoking tobacco, said that the Spaniards "threw fire through their mouths and nostrils."

Undoubtedly, the reason why tobacco was not propagated at that time, was that the first expedition undertaken by the first Spanish explorer and the subsequent three, did not meet with success. But when Miguel López de Legaspi arrived at Tandayak, Samar, February 13, 1565, and took possession of the Philippines, tobacco, which was first used by the first Spanish governor of the Islands, was again seen. Tobacco since 1592 rapidly gained in popularity in the Islands due to the strong propaganda in its favor.

Later, the Spaniards took tobacco seeds to Japan. The Japanese called it *tanpako.*

In 1588, Si-Tik-Hong, Yad-Su and others disputed about the place of origin of tobacco in China. Some held that the Spaniards introduced it in Japan, while others were of the opinion that it was introduced by them in Amoy. The Tartar emperor, in 1641, complained that the Chinese preferred tobacco smoking to "using their bows and arrows."

The world-wide propaganda in favor of tobacco, it seems, met with the strong opposition of the Church and other prominent people. Excommunication of those addicted to the weed was not infrequent.

Victor Mennier, one of the most noted opponents of the use of tobacco, said: "Despots should erect statues in honor of Juan Nicot who gave to mankind the strongest douse for human energy." Mme. Stendhal said: "Turkey presents the picture of gloom; Germany is dream-bound; Spain in a state of somnambulism and France is gazing vacantly into space. This apparent mystery of national suicide is attributable to the use of tobacco in its various forms. Even limited indulgence is

bound to seriously affect the human intellect, and man will sink to the level of the monkey."

Voltaire, Rousseau and Mirabeau, at that time world-famous, also disapproved of the use of tobacco, and Montesquieu, desiring to restrict its use, worked for the passage of a law that would stop workingmen from indulging in tobacco by the levy of a heavy tax calculated to raise the retail price of cigars, cigarettes, plug and leaf tobacco.

Peter the Great of Russia, who was strongly criticized by the clergy for permitting the free entry of tobacco into his domains, said in reply to attacks: "Tobacco should be the biggest source of revenue of kings in times to come, but in Russia I am encountering many obstacles in my fight to extend its use. The Orthodox Patriarch hates the Turks who use tobacco and relentlessly persecutes the Russians who smoke it, threatening them with excommunication. Under all the circumstances, not being able to stem the tide of clerical opposition, I have thought much of what to do and now believe to have found a way to render that opposition harmless and obtain the result I am driving at. That revenue of a measly hundred thousand escudos does not enter into consideration. I am looking for something else and think I have found it. The speculators always were unscrupulous where their profits are concerned, and this leads me to rely on the commercial acumen of the London merchants who will make every effort to popularize tobacco in Russian homes—including those of the priests—despite the opposition of the Patriarch, in the same way as opium was introduced into other countries. Thus, working quietly, I shall accomplish my purpose, and what today yields but little will in time to come become an important source of revenue."

Don José Basco y Vargas, an active and intelligent young man, came to the Philippines as governor in July, 1778. He apparently was familiar with what had been done in regards to tobacco in other countries and seemed to agree with Peter the Great, perceiving in taxes levied on tobacco a valuable aid in defraying public running expenses.

A STUDY OF THE INHERITANCE OF BEARDEDNESS OF RICE IN NATURAL HYBRIDS

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INTRODUCTION

Very little is known about the genetics of rice; much less about that of its awn or beard, and a study of the inheritance of this character is important to the students of genetics in general.

There are two other and more important reasons for an investigation of the inheritance of the rice beard. (*a*) In the Philippines, in Java and probably in all the rice growing countries, where bearded rices are grown, this character is an essential basis of classification. In the Philippines, after classifying rice into glutinous and non-glutinous types, each is then subdivided into the bearded and non-bearded sub-groups. (*b*) In the second place, the beard of rice is at once important and undesirable to the farmer. Bearded rice is practically not subject to the depredation of its two serious bird enemies, the *mayas* Tag., *Munia jagori* Martens and *Orolocha everetti* Tweedd.

The northern rice regions of Luzon grew bearded rice to the practical exclusion of the beardless varieties. In most of the central provinces and in those of the southern parts of the Philippines, the farmers discriminate against the bearded varieties as the beard makes harvesting, threshing and hulling difficult and expensive.

But greater knowledge of the relative yield value of different varieties and the gradual use of threshing and milling machines will finally lead each rice grower to raise both bearded and beardless varieties. The natural creation of plant populations genetically mixed with respect to beardedness may therefore be anticipated and it will be a breeding problem to constantly purify a variety or stock from either bearded or beardless contaminations just as it has been a problem to purify our varieties from colored grains, and in this anticipated work, the method of operation will depend in nature upon the way the character involved behaves in inheritance.

REVIEW OF PAST WORK

The writer is unware of any published report on the inheritance of rice beard except that of Van der Stok from Java. We learned of his study through McKerral.[1]

[1] McKerral, A. Some problems of rice improvement in Burma. The Agricultural Journal of India *8:* 317–330, 1913.

According to him, Van der Stok "found that in cases of highly developed awning the awned variety is dominant to the unawned, but that intermediate forms also make their appearance. In the particular case, where a cross was made between a very short awned variety and an unawned one, the "F" generation was entirely without awns. This apparently shows that different factors are at work to produce this character * * * one of the varieties, however, most desired by millers in Lower Burma, known as Bawyut-Midon and which is at present under study at Hmawbi consists of a mixture of awned and awnless plants. Cultivators say that it produces most awns when the soil is good, and that then the yield is large. What is probably the case is that some samples of seed contain a larger proportion of heterozygotes (awned) than others, and that it is the existence of these, which, by the well known law of the increased vigor of hybrids, accounts for the higher yield obtained."

We may summarize Van der Stok's findings and McKerral's as follows:

1. Beardedness is dominant over beardlessness when the beard is "highly developed," that is, probably when the plant is long bearded.
2. Beardedness in case No. 1 is not completely dominant.
3. Beardedness is not dominant over beardlessness when the bearded plant is short bearded.
4. In the case of No. 2, it is suspected by McKerral that more than one factor are involved in the production of beardedness.

THE EXPERIMENTS

MATERIALS AND METHODS

The varieties used in this work were Nagdami and Putyucanon. These are two of the three varieties which I reported in 1919 as containing both awned and awnless plants.[2]

Nagdami.—On October 21, 1919, when a planting of a beardless variety, Nagdami, was harvested, there were found a number of plants which had bearded grains but which were in other respects apparently Nagdami. A portion of the harvest contained 98 beardless individuals and 47 bearded plants. The bearded individuals had both beardless and bearded grains and roughly of two sorts. In one of these the beard was comparatively shorter and there were a greater number of beardless grains. For convenience I am calling this group "short beard." The other group contains comparatively longer beards and a

[2] Mendiola, N. B. A review of the rice investigation, at the College of Agriculture. The Philippine Agriculturist *8:* 145–160, 1919.

fewer number of beardless grains or none at all. This group was called "long beard." Seeds were obtained from the main culm of different plants of each group and sub-group.

All the plantings which this work involved were can cultures. The first planting was made on November 5, 1919. Ten cans were planted to seeds of beardless plants, each can containing grains from one plant. More than four grains were planted in each can, but later the seedlings were thinned to four in each can in this and all other plantings.

Ten cans were planted in the same manner to seeds of "short beard" plants and another ten cans to seeds of "long beard" plants. However, instead of planting all bearded grains from each plant and in each can, there were planted two beardless and two bearded grains, the pair occupying diagonal corners.

For convenience, these three plantings were designated as follows:

Culture I. Seeds were from beardless plants. (*See* Plate I.)

Culture II. Seeds were from "short beard" plants.

Culture III. Seeds were from "long beard" plants.

For types of bearded plants, see Plates II and III.

These cultures were harvested on March 3, 1920. The harvests from Cultures II and III are described in Tables A_1 and B_1.

From this harvest certain seeds were selected and planted in cans in September 15–21, 1920. By referring to Tables A_1 and B_1 and using the pedigree number of the plant, the character of the seeds may be learned. The second plantings were harvested on January 14, 1921. The results of Cultures II and III are shown in Tables A_2 and B_2.

A third generation plantings were made, and these were harvested on July 5, 1921. The results in Culture II and Culture III are described in Tables A_3 and B_3.

Putyucanon.—Putyucanon is a bearded variety. In the October, 1919, harvest of this rice there were found ten beardless individuals which, except for their lack of beard, were apparently Putyucanon. Pedigree cultures similar to I and III, except that the sources of the seeds were not confined to main culms, were run for two generations at the same time as those of Nagdami. It was not possible to have a culture similar to II, because the bearded individuals were uniformly "long beard." The Putyucanon cultures were numbered:

Culture IV. Seeds were from apparently beardless plants.

Culture V. Seeds were from bearded plants.

The results of Culture IV in the first and second generations are shown in Tables C_1 and C_2, respectively, and of Culture V in Tables D_1 and D_2.

RESULTS

CULTURE I

The seeds in this culture were from supposedly pure Nagdami (beardless) plants. In three successive generations, nothing but beardless offspring were obtained.

CULTURE II

Half of the parent seeds of the first generation were beardless and half were bearded, but all were from "short beard" plants. The results in the first, second, and third generations are shown in Tables A_1, A_2, and A_3, respectively.

TABLE A_1.—*Offspring of bearded and non-bearded grains of "short beard" plants of Nagdami*

Parent plant number	Kind of grain used	Parent grain	Offspring
II-1	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
II-2	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
II-3	a	1	Do.
		2	Do.
	na	1	Do.
		2	Missing.
II-4	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
II-5	a	1	Short beard.
		2	Beardless.
	na	1	Do.
		2	Long beard.
II-6	a	1	Beardless.
		2	Long beard.
	na	1	Do.
		2	Short beard.
II-7	a	1	Long beard.
		2	Do.
	na	1	Beardless.
		2	Do.
II-8	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
II-9	a	1	Short beard.
		2	Long beard.
	na	1	Do.
		2	Do.
II-10	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.

NOTE.—In this and other tables "a" stands for awned grain and "na" for awnless grain. It was decided to use these symbols instead of any other that might be confused with bearded and beardless, to show that "a" or "na" refers only to the grain and not to the plant as a whole. The latter is described as bearded or beardless.

TABLE A_2.—*Second generation offsprings in Culture II*

Parent			Description of offspring
	Long beard		
II–2	a	1—1	long beard.
II–2	a	1—2	long beard.
II–2	a	1—3	long beard.
II–2	a	1—4	long beard.
	Long beard		
II–2	na	2—1	long beard.
II–2	na	2—2	long beard.
II–2	na	2—3	long beard.
II–2	na	2—4	long beard.
	Long beard		
II–4	a	1—1	long beard.
II–4	a	1—2	long beard.
II–4	a	1—3	long beard.
II–4	a	1—4	long beard.
	Long beard		
II–4	na	1—1	long beard.
II–4	na	1—2	long beard.
II–4	na	1—3	long beard.
II–4	na	1—4	long beard.
	Short beard		
II–5	a	1—1	short beard.
II–5	a	1—2	long beard.
II–5	a	1—3	short beard.
II–5	a	1—4	long beard.
	Beardless		
II–5	a	1—1	beardless.
II–5	a	1—2	beardless.
II–5	a	1—3	beardless.
II–5	a	1—4	beardless.
	Beardless		
II–5	na	1—1	beardless.
II–5	na	1—2	beardless.
II–5	na	1—3	beardless.
II–5	na	1—4	beardless.
	Beardless		
II–7	na	1—1	beardless.
II–7	na	1—2	beardless.
II–7	na	1—3	beardless.
II–7	na	1—4	beardless.
	Short beard		
II–9	a	1—1	short beard.
II–9	a	1—2	short beard.
II–9	a	1—3	beardless.
II–9	a	1—4	beardless.

TABLE A_2.—*Second generation offspring in Culture II*—Continued.

Parent			Description of offspring
	Long beard		
II–10	a	1—1	long beard.
II–10	a	1—2	short beard.
II–10	a	1—3	short beard.
II–10	a	1—4	short beard.
	Long beard		
II–10	na	1—1	short beard.
II–10	na	1—2	short beard.
II–10	na	1—3	short beard.
II–10	na	1—4	short beard.

TABLE A_3.—*Third generation offspring in Culture II*

Pedigre number of parent			offspring.
	Long beard		
II–4	a	1—3—1	short beard.
II–4	a	1—3—2	short beard.
II–4	a	1—3—3	short beard.
	Short beard		
II–5	a	1—1—1	beardless.
II–5	a	1—1—2	short beard.
II–5	a	1—1—3,	beardless.
II–5	a	1—1—4	short beard.
	Long beard		
II–5	a	1—2—1	beardless.
II–5	a	1—2—2	long beard.
II–5	a	1—2—3	beardless.
II–5	a	1—2—4	short beard.
	Beardless		
II–5	na	1—1—1	beardless.
II–5	na	1—1—2	beardless.
II–5	na	1—1—3	beardless.
	Beardless		
II–5	na	1—3—1	beardless.
II–5	na	1—3—2	beardless.
II–5	na	1—3—3	beardless.
II–5	na	1—3—4	beardless.
	Beardless		
II–5	na	1—4—1	beardless.
II–5	na	1—4—2	beardless.
	Beardless		
II–5	a	2—1—1	beardless.

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TABLE A_3.—*Third generation offspring in Culture II*—Continued.

Beardless

Pedigree number of parent			Offspring
II–5	a	2—2—1	beardless.
II–5	a	2—2—2	beardless.
II–5	a	2—2—3	beardless.

Beardless

II–5	a	2—3—1	beardless.
II–5	a	2—3—2	beardless.
II–5	a	2—3—3	beardless.

Beardless

II–5	a	2—4—1	beardless.
II–5	a	2—4—2	beardless.

CULTURE III

Half of the parent seeds of the first generation were beardless and half were bearded, but all were from "long beard" plants. The results in the first, second, and third generations are shown in Tables B_1, B_2, and B_3, respectively.

TABLE B_1.—*Offspring of bearded and non-bearded grains of "long beard" plants of Nagdami*

Parent plant number	Kind of grain used	Parent grain	Offspring
III-1	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
III-2	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
III-3	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
III-4	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
III-5	a	1	Do.
		2	Do.
	na	1	Short beard.
		2	Long beard.
III-6	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
III-7	a	1	Missing.
		2	Do.
	na	1	Short beard.
		2	Missing.
III-8	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
III-9	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
III-10	a	1	Do.
		2	Missing.
	na	1	Short beard.
		2	Missing.

TABLE B_2.—*Second generation offspring in Culture III*

Parent		Offspring
	Long beard	
III–2	a........1—1	short beard.
III–2	a........1—2	long beard.
III–2	a........1—3	long beard.
III–2	a........1—4	long beard.
	Long beard	
III–2	na........1—1	long beard.
III–2	na........1—2	long beard.
III–2	na........1—3	long beard.
III–2	na........1—4	long beard.
	Short beard	
III–5	na........1—1	short beard.
III–5	na........1—2	long beard.
III–5	na........1—3	long beard.
III–5	na........1—4	long beard.
	Long beard	
III–6	a........1—1	short beard.
III–6	a........1—2	short beard.
III–6	a........1—3	short beard.
III–6	a........1—4	short beard.
	Short beard	
III–10	na........1—1	short beard.
III–10	na........1—2	long beard.
III–10	na........1—3	long beard.
III–10	na........1—4	short beard.

TABLE B_3.—*Third generation offspring in Culture III*

Parent		Offspring
	Long beard	
III–2	na..1—1—1	short beard.
III–2	na..1—1—2	short beard.
III–2	na..1—1—3	short beard.
	Short beard	
III–2	a....1—1—1	short beard.
	Long beard	
III–2	na..1—2—1	short beard.
III–2	na..1—2—2	short beard.
III–2	na..1—2—3	short beard.
	Long beard	
III–2	na..1—3—1	short beard.
III–2	na..1—3—2	short beard.
III–2	na..1—3—3	short beard.

CULTURE IV

The seeds in the first generation of this culture came from beardless plants which appeared like Putyucanon but without beard. The culture did not go beyond the second generation.

The results in the first and second generations are shown in Tables C_1 and C_2.

TABLE C_1.—*Offspring of beardless plants (Putyucanon x var.)*

Parent plant number	Parent grain	Offspring
IV-1	1	Short beard.
	2	Do.
	3	Do.
	4	Do.
IV-2	1	Long beard.
	2	Do.
	3	Do.
	4	Do.
IV-3	1	Short beard.
	2	Do.
	3	Do.
	4	Missing.
IV-4	1	Short beard.
	2	Do.
	3	Do.
	4	Missing.
IV-5	1	Long beard.
	2	Do.
	3	Short beard.
	4	Do.
IV-6	1	Do.
	2	Do.
	3	Do.
	4	Do.
IV-7	1	Do.
	2	Do.
	3	Do.
	4	Beardless.
IV-8	1	Short beard.
	2	Do.
	3	Do.
	4	Do.
IV-9	1	Long beard.
	2	Do.
	3	Do.
	4	Do.
IV-10	1	Do.
	2	Do.
	3	Do.
	4	Beardless.

TABLE C_2.—*Second generation offspring in Culture IV*

Parent	Offspring
Short beard	
IV–1—1—1	short beard.
IV–1—1—2	short beard.
IV–1—1—3	short beard.
IV–1—1—4	short beard.
Short beard	
IV–4—1—1	short beard.
IV–4—1—2	short beard.
IV–4—1—3	short beard.
IV–4—1—4	missing.
Long beard	
IV–5—1—1	short beard.
IV–5—1—2	long beard.
IV–5—1—3	long beard.
IV–5—1—4	short beard.
Short beard	
IV–7—3—1	short beard.
IV–7—3—2	short beard.
IV–7—3—3	short beard.
IV–7—3—4	short beard.

TABLE C_2.—*Second generation offspring in Culture IV*—Continued.

Parent		Offspring
	Beardless	
IV-7—4—1		short beard.
IV-7—4—2		short beard.
IV-7—4—3		short beard.
IV-7—4—4		short beard.
	Long beard	
IV-9—1—1		short beard.
IV-9—1—2		short beard.
IV-9—1—3		short beard.
	Long beard	
IV-10—1—1		short beard.
IV-10—1—2		short beard.
IV-10—1—3		short beard.
IV-10—1—4		short beard.

CULTURE V

Half of the parent seeds of the first generation were beardless and half were bearded, but all were from "long beard" plants of supposedly pure Putyucanon. The results in the first and second generations are shown in Tables D_1 and D_2, respectively.

TABLE D_1.—*Offspring of bearded and non-bearded grains of "long beard" plants of Putyucanon*

Parent plant number	Kind of grain used	Number	Offspring
V-1	a	1	Long beard.
		2	Short beard.
	na	1	Do.
		2	Do.
V-2	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
V-3	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
V-4	a	1	Do.
		2	Do.
	na	1	Do.
		2	Short beard.
V-5	a	1	Do.
		2	Do.
	na	1	Beardless.
		2	Do.
V-6	a	1	Short beard.
		2	Do.
	na	1	Long beard.
		2	Do.
V-7	a	1	Do.
		2	Do.
	na	1	Do.
		2	Do.
V-8	a	1	Do.
		2	Missing.
	na	1	Do.
		2	Do.
V-9	a	1	Long beard.
		2	Do.
	na	1	Do.
		2	Do.
V-10	a	1	Short beard.
		2	Do.
	na	1	Long beard.
		2	Missing.

TABLE D_2.—*Second generation offspring in Culture V*

Parent	Offspring
Short beard	
V–1 a—2—1	short beard.
V–1 a—2—2	short beard.
V–1 a—2—3	short beard.
V–1 a—2—4	short beard.
Long beard	
V–2 a—1—1	short beard.
V–2 a—1—2	short beard.
V–2 a—1—3	long beard.
V–2 a—1—4	short beard.
Long beard	
V–2 na—1—1	long beard.
V–2 na—1—2	short beard.
V–2 na—1—3	short beard.
V–2 na—1—4	short beard.
Short beard	
V–5 a—1—1	short beard.
V–5 a—1—2	short beard.
Short beard	
V–6 a—1—1	short beard.
V–6 a—1—2	long beard.
V–6 a—1—3	short beard.
Long beard	
V–9 a—1—1	short beard.
V–9 a—1—2	short beard.
V–9 a—1—3	beardless.
V–9 a—1—4	short beard.
Short beard	
V–9 na—1—1	short beard.
V–9 na—1—2	short beard.
V–9 na—1—3	short beard.
V–9 na—1—4	missing.

DISCUSSION OF RESULTS

NAGDAMI X VAR.

A case of natural hybrids.—The appearance of bearded plants in a beardless variety or beardless individuals in a bearded race might be due either to a mechanical contamination, to mutation or to natural hybridization. In the case of the former two events, the contaminations or the mutations should come true to type as early as in the first generation unless they cross-breed with the stock or the parent plants, in which case the final phenomenon involved is natural hybridization. Furthermore, the mutants or mechanical contaminations do not usually bear a Mendelian ratio to the material contaminated or to the parent plants from which the mutations arose.

The bearded Nagdami plants were evidently not chance contaminations for they were Nagdami except for presence of awn. Moreover, the cultures showed that they did not come true to type. And for this last reason, we may at once dismiss any suspicion that they were mutations.

The fact that there was segregation into beardless, short bearded and long bearded types proves that *we are dealing with a case of natural hybrids.* We are therefore justified from this point on to designate this natural hybrid as *Nagdami x var.*

Beardedness is dominant over beardlessness.—To prove that beardedness is dominant over beardlessness, in a given case, it is only necessary to show the existence of heterozygous bearded plants and the absence of heterozygous beardless individuals. Plants II–5, II–6, and II–7 (Table A_1); II–9a—1, Table A_2; III–5a—1—1 and III–5a—1—2 (Table A_3) all short bearded plants, produced both bearded and non-bearded offspring. It is probable that had more than four plants been raised from each parent, there would have been a greater number of examples of heterozygous bearded plants. There is only one chance at most out of four for a beardless plant to appear among the descendants of monohybrid heterozygous bearded parents. That some of the suspected heterozygous bearded plants which did not produce any beardless progeny among the only four grown, in the first generation, were really heterozygous, is proved by the fact that in later generations, they produced beardless descendants. This was the case with plants II–9 and III–5.

Without exception, all beardless plants at the beginning of the experiment with Nagdami and *Nagdami x var.* or all those which came out in later generations as segregates, produced invariably nothing but beardless plants.

From this discussion it may be concluded that *beardedness is dominant over beardlessness* in *Nagdami x var.* rice.

Number of factors involved.—When only one factor represents a character or when the hybrid involves only one pair of allelemorphs, the F_2 ratio which the segregates follow is 3 : 1 when dominance is complete; 1 : 2 : 1, when dominance is incomplete; or 2 : 2 when the ratio is a modified kind.

From the results shown in Table A_1, it is seen that out of 39 offspring of ten supposedly heterozygous individuals, 34 were bearded and 5 were beardless. Since plant II–9 which did not produce any beardless plant in the first generation did so in a later one, we may make a correction in the ratio 34 : 5 by assuming that the four bearded individuals which were the offspring

of plant II–9 and which were included in 34 were 3 bearded and 1 beardless plants. Making this correction, the ratio becomes 33:6. This ratio is obtained on the assumption that short bearded plants were heterozygous.

If we try to get the ratio of segregation only from those cases where segregation into bearded and beardless plants actually took place, we find that plants II–5, II–6, II–7, II–9a—1, III–5a—1—1, and III–5a—1—2 are involved. The offspring of these plants were in the following ratios:

Offspring of II–5	2 bearded: 2 beardless.
Offspring of II–6	3 bearded: 1 beardless.
Offspring of II–7	2 bearded: 2 beardless.
Offspring of II–9a—1	2 bearded: 2 beardless.
Offspring of III–5a—1—1	2 bearded: 2 beardless.
Offspring of III–5a—1—2	2 bearded: 2 beardless.
Total	13 bearded: 11 beardless.

Because it is not correct to consider a short bearded plant heterozygous until it behaves as such in heredity, we will disregard the ratio 33 : 6 altogether and study instead the ratio 13 : 11. This approaches the modified monohybrid 2 : 2 and the modified dihybrid ratio 9 : 7 more than it does any other. It is now a question as to which of these theoretical ratios more closely fit the observed one.

When the 13 : 11 ratio is compared with 2 : 2, the deviation is 0.167 and the probable error is 0.275. The quotient obtained by dividing the deviation by the probable error is 0.6. Compared with the 9 : 7 ratio, the quotient obtained by dividing the deviation by the probable error is 0.3.

It is thus seen that although 13 : 11 fits 9 : 7 better than it does 2 : 2 it fits both significantly by odds of 1 to 1.

Compared with the ratio 3 : 1, the deviation divided by the probable error equals 3.5. This represents odds of 53.95 to 1.

With all the results above, it is not possible to draw any definite conclusion as to the actual number of factors representing beardedness. *It may however be considered very probable that if there is more than one factor involved, they can not be more than two.*

Dominance of beardedness over beardlessness.—While the offspring of the heterozygous plants can be roughly classified into "bearded" and "beardless" groups, a number of the bearded individuals may be described as intermediate in length of beard and number of awned and awnless grains between the long bearded and the beardless kinds. There appeared different gradations from one group to the other. At one extreme of

this series of intermediates are found plants which show practically no beard. At most they have only one grain possessing beard and this is so short in some cases (see Plate II) that it is visible only with difficulty. The beards in the panicles shown in Plate II will escape notice in field examination. This point is important in connection with field selection of rice for beardlessness.

The majority of the "long beard" plants did not produce any beardless offspring while the majority of the "short beard" plants produced beardless plants indicating that the intermediates were probably all heterozygous while the "long beard" ones were homozygous.

There must of course be a point where it will be quite impossible to tell whether a plant is homozygous or heterozygous. *These experiments therefore confirm Van der Stok's observation that the dominance of beardedness over beardlessness is not perfect.*

PUTYUCANON X VAR.

The conclusions which have just been drawn in the discussion of results with *Nagdami x var.* obtain also in the case of *Putyucanon x var.*

There is however one point that deserves scrutiny. Table C_1 shows the offspring of beardless plants. The offspring were all bearded, with two exceptions. Plants IV–7 and VI–10 each gave one beardless progeny out of four. The parents which were apparently beardless were evidently heterozygous. If the parents were really pure beardless then they should have been homozygous recessives and should not have shown segregation in the F_2 generation, unless we assume that beardlessness is dominant in this case over beardedness. However, the F_2 results in Table C_2 as well as the results shown in Tables D_1 and D_2 show that even in this case beardedness is still the dominant character. It was more probable that beardlessness in this case was only apparent, that the plants were really bearded but that through the effects of external causes, such as the effects of soil conditions, of physical disturbance and of other factors, the beards became so short as to escape notice, or that the grains bearing the beard were lost. Another possibility is that they were really beardless parents which were cross-pollinated by their bearded companions.

In either event, it may be assumed that Putyucanon was once a beardless variety and that cross-breeding at one time with a bearded sort and mass selection for bearded individuals, a prac-

tice which we may assume to be followed by those who discriminate against beard, have gradually eliminated the beardless strain which may become re-crossed with the bearded individuals upon their appearance.

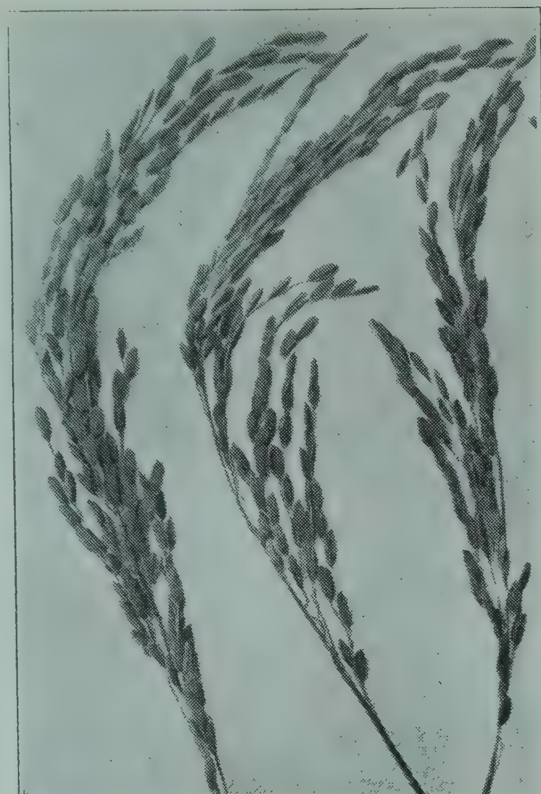
The results discussed from the applied standpoint.—We have seen in Tables A_1 and D_1 that awnless grains of bearded plants produced bearded plants. It is to be concluded that any selection for beardless individuals can not be done in a pile of homozygous and heterozygous grains. If bearded and beardless plants are threshed together, more heterozygous awnless grains will be found in the pile as the operations will cause the loss of the beard from a number of the awned grains.

If roguing or mass selection is practiced in a field containing pure bearded and beardless plants as well as impure bearded ones with a view of eliminating the bearded strains, the number of plants of the bearded group will tend to decrease. However, mass selection alone or roguing will not at once or for any short time free a given stock from "beardedness" factors, for the heterozygous plants with very short and hardly noticeable beard are very likely to escape attention and they will therefore have a chance in the following generation to produce bearded plants again.

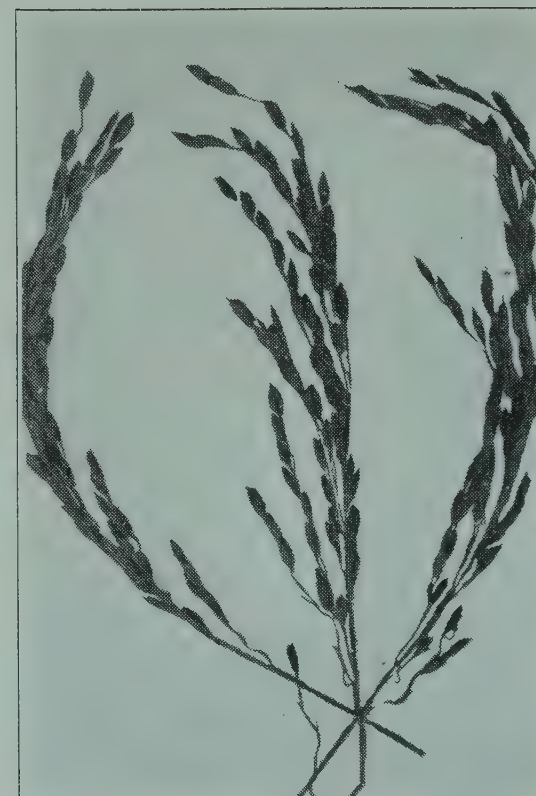
If only mass selection could be practiced, it would be better to mass-select carefully for beardless plants than rogue bearded individuals. But even mass selection for beardless plants is not the quickest way of purifying a stock from beardedness impurity for there is always the possibility that some apparently beardless plants are really heterozygous and bearded genetically except that they might have lost the bearded grains through shattering or through the attack of birds and other enemies.

The quickest way of course of isolating the bearded "blood" from the "beardless" is by line selection, by plant-to-row tests. These will at once reveal what plants are heterozygous and what plants are homozygous, irrespective of their phenotipic appearance.

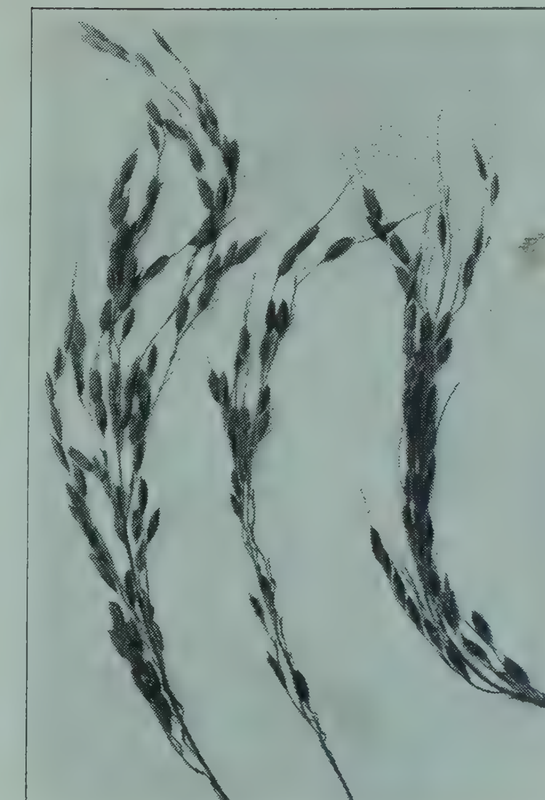
The above discussion applies with equal force to the purification of a bearded variety from genetic impurities as regards beardlessness. Roguing or mass selection meets here a greater difficulty for beardedness is dominant over beardlessness and in heterozygous plants covers or hides beardlessness. There is more necessity in such case, for quickest results, of using line selection in the work of purifying a given stock.



(a) Panicles of pure Nagdami plants



(b) Typical very short bearded (Nagdami x var.). The two panicles at the left have only one bearded grain. This is at the uppermost part.



(c) Types of bearded panicles in which the beards are easily visible

SUMMARY OF CONCLUSIONS

1. This paper reports a case of natural rice hybrids in which the character beardedness or beardlessness and the varieties Nagdami and Putyucanon are involved. These natural hybrids may be designated as *Nagdami x var.* and *Putyucanon x var.*

2. A study of three generations of *Nagdami x var.* and of two generations of *Putyucanon x var.* has shown that beardedness in these varieties is partially dominant over beardlessness.

3. It is probable that if more than one factor is responsible for the production of "bearded" character, not more than two factors are involved.

4. Selection of seeds in the pile, or even mass selection or roguing in the field will purify only slowly and with difficulty a genetic mixture of beardless and bearded individuals. Line selection will be the most efficient method which may be used in the process of purification.

SOME VARIETIES OF CITRUS FRUITS FOR THE PHILIPPINES

By F. G. Galang, *Horticulturist, Bureau of Agriculture*

The conditions for an extensive citrus industry in the Philippines are in most respects very desirable. At present there are only three provinces in the Archipelago that are engaged in a more or less limited way in the cultivation of this important crop. These are the Provinces of Batangas, Ilocos Norte and Nueva Ecija. In Ilocos Norte the town of Bangui is the one mostly concerned in this industry and Gapan in the Province of Nueva Ecija. In Batangas it is a well-known fact that previous to the eruption of Taal Volcano in 1911 the citrus industry was flourishing, and the native mandarin oranges were shipped by the carload into the Manila markets. Although citrus fruits in the Philippines probably will never become an export crop, still there is a field for a citrus industry producing high grade fruit for home consumption. The custom house statistics showing that the importation of citrus fruits into the Islands is increasing every year, and the fact that American, Japanese and Chinese grown fruits are found so commonly in the Manila markets, are evidence that there is a place for choice Philippine citrus fruits. To supplant the use of imported fruits in the Philippine Islands it is first necessary that the proper varieties should be grown. With the determination of this point in view the Bureau of Agriculture has introduced American, Japanese, Chinese, and Australian varieties into the Philippines.

SWEET ORANGE (*Citrus sinensis*).—Of the sweet orange varieties commonly grown in America which so far have been tried and fruited at Lamao Experiment Station it has been found that they do not give the same quality of fruits here, as is obtained in America, unless possibly they are grown at the higher altitudes. Such varieties are the Washington Navel, Whittaker, Pineapple and Foster. The difficulty is in the coarsening of the fruit and the flesh is fibrous and full "rag." The taste also, though sweet, is insipid and lacks the flavor of the same fruits grown under temperate climatic conditions. Although these introduced varieties present these characteristics under Philippine conditions yet they are far superior than the commonly culti-

vated native sweet oranges. Should the grower desire to grow the introduced sweet oranges the following varieties may be recommended: The Valencia, Jaffa, Ruby, Mediterranean, Larrantta, Dugat, Carlton, Duroi, Excelsior, Boone, Enterprise and one of the Japanese oranges have shown themselves to produce better fruits under the Philippine conditions and in addition are not as susceptible to the disease called citrus canker as are other orange varieties. Because of its superior quality and flavor the Cuyo orange obtained from Palawan is also worth recommending. This orange was introduced to the Bureau from Cuyo Islands in 1912. It is similar in appearance to other Philippine oranges; 72 mm. long, 76 mm. in diameter, weighing an average of 215 grams; skin green, 5 mm. thick; very sweet, juicy and of excellent quality, and nearly seedless.

MANDARIN ORANGE (*Citrus nobilis* variety *deliciosa*).—Among the introduced mandarin orange varieties there are several which from experience so far gained, do exceedingly well under Philippine conditions. Preëminent among these are the Szinkom and the Kishiu, both of which were introduced in September, 1912, from the Department of Agriculture, Saharanpur, India.

The fruits of the Szinkom are numerous, 7 to 8 cm. in diameter, globose, with smooth thin skin, from green to greenish yellow on the tree, separating readily from the flesh; flesh pinkish, good texture, containing very abundant sweet and well flavored juice; seeds present but not numerous. If necessary a perfect orange color of the skin may be obtained by ripening methods after picking. It is very prolific and in addition has the most advantageous feature of being resistant to the disease citrus canker. Of the two crops of fruits observed at Lamao Experiment Station no fruit has ever been observed to be cankered.

The Kishiu has fruited for the first time at Lamao during 1916. The fruits are sweeter than the Szinkom and possess many of the characteristics of the latter except is not being borne as abundantly. It should be mentioned also that there are several other introduced as well as native trees of the mandarin type which bear very excellent fruits, among these are the Tizon, Oneco, and Dancy. In the experience of the writer, however, the Tizon, although it has yielded very desirable fruits, yet it is rather a shy bearer.

LEMON (*Citrus limonia*).—Of the lemon varieties, there are many grown commercially in America which bear desirable fruits under Philippine conditions; such varieties grown at Lamao are

the Clarke, Villafranca, Thornless, Valencia, and Messina. All have fruited at the Lamao Experiment Station although not very prolificly and were found to be of very good quality. Since lemon varieties as far as is known are to some extent susceptible to citrus canker a very desirable substitute is found among the lime varieties. The Tahiti lime is found to be resistant to the citrus canker as pointed out by Wester and Lee and substantiated by the writer's observations, and in addition has the most desirable fruits for ades and table use. Although the writer realizes that the Tahiti lime is considered a poor keeper it is believed careful handling as pointed out by Hume would avoid this difficulty.

Another fruit of exceptional merit is the Limon-real (*Citrus excelsa*) described by Wester. The trees of this species are continuous and prolific bearers under Philippine conditions and in addition are to some extent resistant to citrus canker. Although not the ordinary commercial type of lemon it is perhaps a more desirable substitute because of its large size and flavor.

The *Alsem* (*Citrus webberii*) is found also to make a good substitute for lemons and limes for local consumption. It has been very productive with fruits of good appearance and quite juicy, free from fiber and with a few seeds. The flesh is grayish and aromatic. The juice makes a good ade. One objectionable point is its susceptibility to rindborer, but this can be remedied by the application of an insecticide during the fruiting season.

PUMMELO AND GRAPEFRUIT (*Citrus maxima*).—American grapefruits mature here with a flavor and sweetness, equal to those of American grown fruits of the same varieties; however, they are not desirable for culture because of their extreme susceptibility to citrus canker. Many varieties of pummelos have also been introduced from China and Siam. Among these is a pummelo introduced by the Bureau of Agriculture from Siam, the fruits of which are seedless, the flesh white, and the flavor very desirable. Trees of this variety have been found to canker slightly but never severely; two crops of fruits have been borne and in no case has a fruit shown a single canker. This variety is known as the Siam and of the pummelos it gives most promise of being canker resistant. The fruits are of the pummelo rather than the grapefruit type, that is, somewhat pear-shaped, thicker-skinned and larger than the American grapefruit. It should be noted also that the walls of the sections of these fruits are somewhat thick and coarse and detract from the otherwise great value of the fruit. Another variety of the same introduction

Citrus webberii var. Montona on orange stock, Lamao Experiment Station

that is worth mentioning is the Yugelar. Though it is seeded, the pulp is juicy and very sweet, with excellent quality. To those who desire to try the grapefruits the Triumph is especially recommended. The fruit averages about 500 grams in weight, about 95 mm. long and 98 mm. across; rind smooth; flesh medium juicy and sweet, quality good and of excellent flavor. Seeds are abundant.

STOCKS FOR COMMERCIAL CITRUS VARIETIES

It may be well at this time also to consider the experience gained at the Lamao Experiment Station with regard to citrus stocks. In the past, the pummelo has been largely used as a stock, however at Lamao, scions of *C. nobilis, C. sinensis,* and *C. limonia* on pummelo stock, although at first making a good progress, have after the course of a few months become less active. Lee has shown that pummelo as a stock is conducive to severe attacks of mottled leaf, except in the cases of pummelo scions on pummelo stock. The use of pummelo as a stock is therefore now being abandoned at the Lamao Experiment Station.

The lemon and sweet orange have been shown by Fawcett to be more susceptible to gummosis than the sour orange. The sweet orange has proven to be a good stock in all species of citrus, but because of its susceptibility to diseases like the one mentioned above and to that of rootrot and barkrot is not here recommended for stock purpose. The cabuyao (*C. hystrix*) has also been proven to be a good stock if not for its soft wood characteristics which cause trees to break and fall easily.

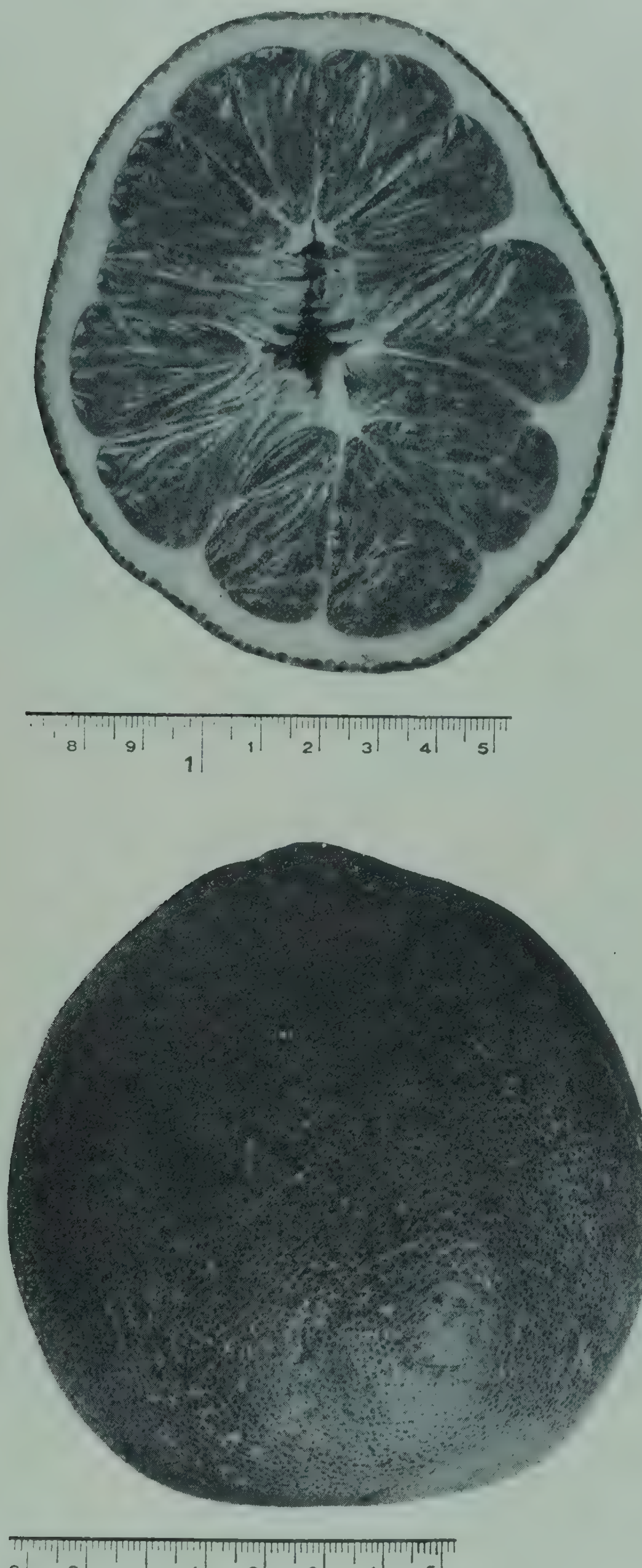
Mandarin orange seedlings (*Citrus nobilis*) have been used rather extensively, although this species as a stock does not give a rapid growth to the tree. The growth is firm and solid, but also has the disadvantage of suckering more freely than the other species.

The calamondin (*C. mitis*) has also been used on a large scale, and the trees budded upon this make a very desirable growth and a good bud union especially in the case of the sweet orange, mandarin orange and lime. However, a minor trouble has been found on this species, that is, the presence of spines. This can be overcome by trimming the thorns of the stock previous to budding. The sour orange (*C. aurantium*) according to Fawcett is resistant to gummosis; and it has been used at Lamao as a stock and to the present time is entirely satisfactory.

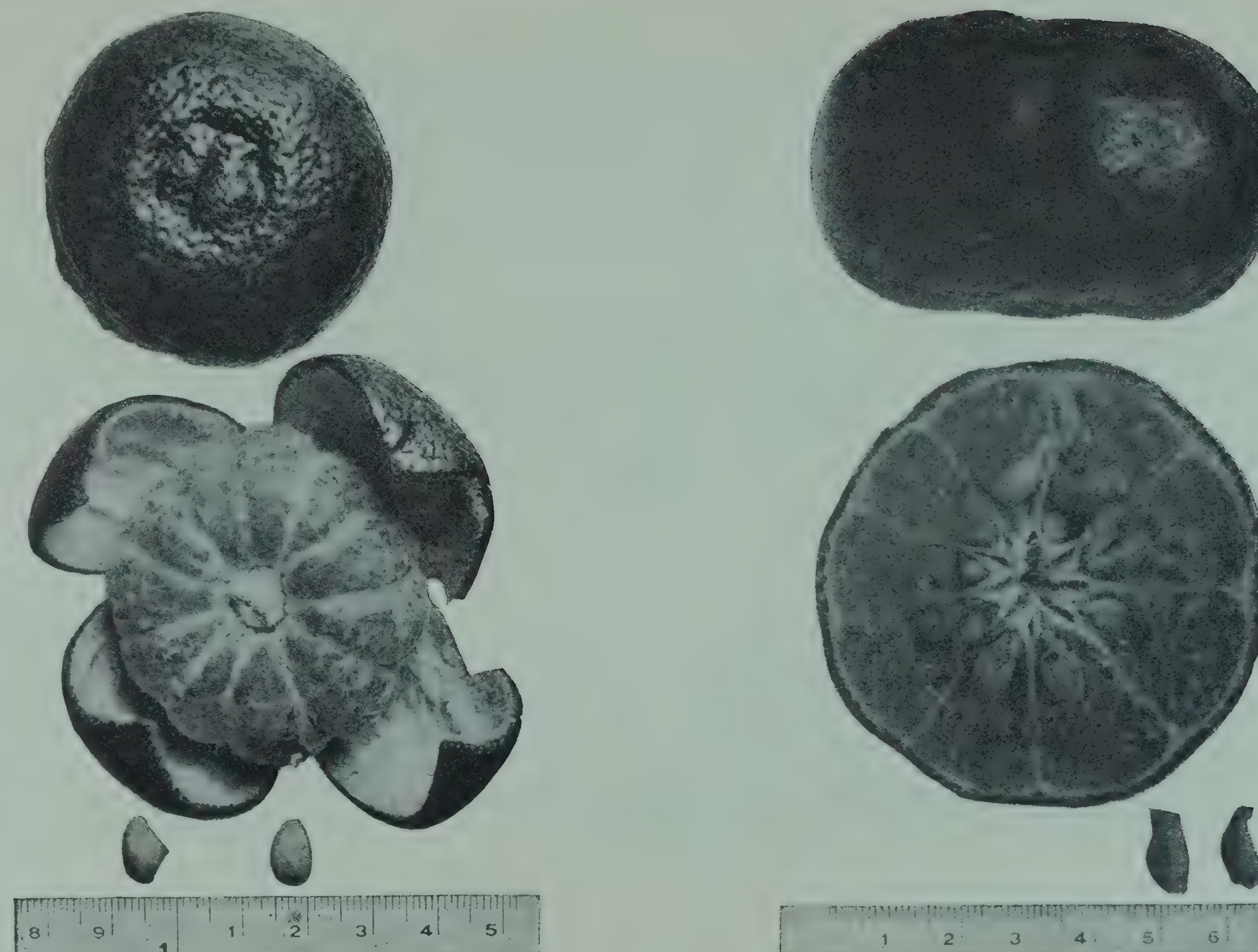
Wester has published several photographs showing the perfect bud union of various species on what he has called Kalpi (*C. webberii*). This stock makes a moderate firm growth and

is probably one of the most desirable of the native varieties as a stock for Philippine conditions. A variety of the species was brought to Lamao from the Mountain Province at an elevation of about 4,500 feet. This is perhaps to be preferred to the *C. webberii* of the lowlands since possibly it is more resistant to cold, and it is believed that this particular variety would make an excellent stock for the United States and other citrus growing countries. For one who wishes to grow citrus for citric acid and the rind oils this variety is highly commended.

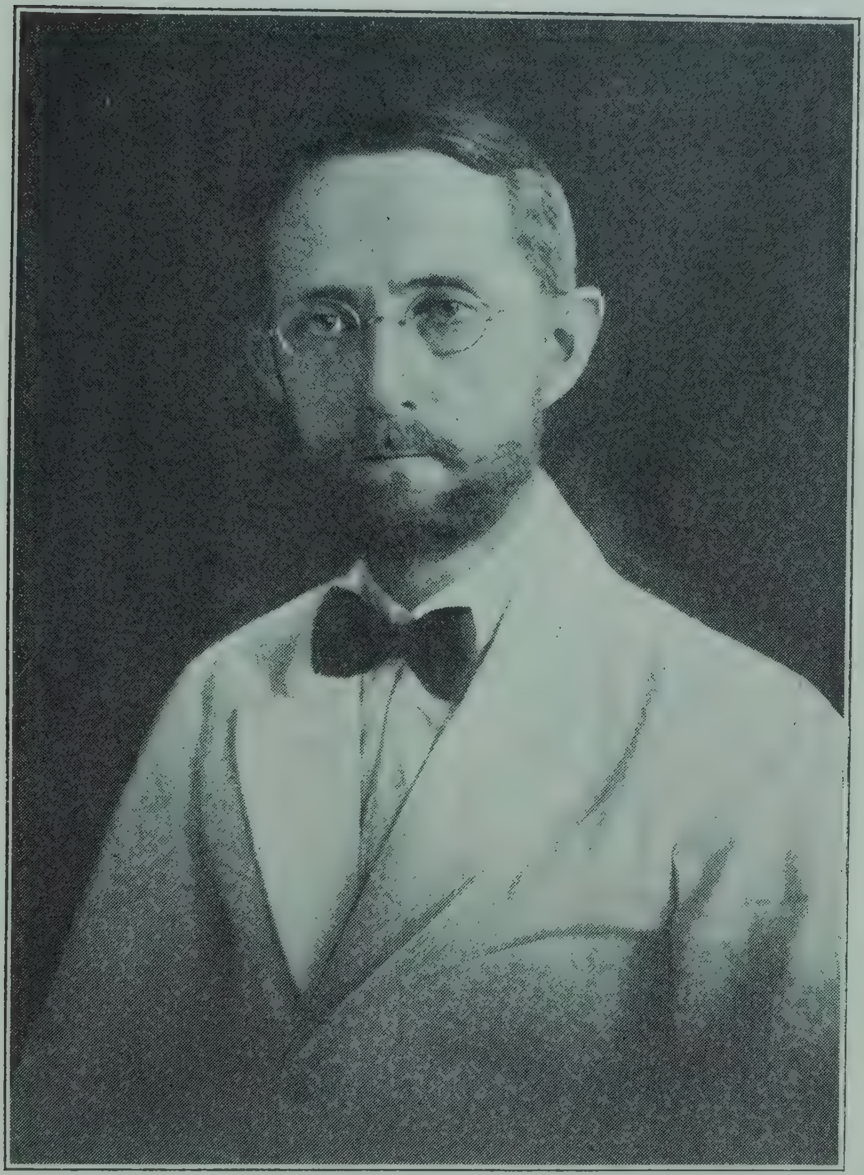
Acknowledgment is due to Mr. H. Atherton Lee, Mycologist, Bureau of Science, Manila, for his valuable suggestions in the preparation of this article especially in regards to diseases.



The Siamese Seedless Pomelo, *Citrus decumana*



Types of *Citrus nobilis* Lour



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Author of *The Coconut: Its Culture and Uses*, *The Mango*, *Plant Propagation in the Tropics* and many articles on tropical agriculture.

THE COMMERCIAL AND INDUSTRIAL FAIR OF 1922

The feature of this year's carnival in Manila that commanded attention was the Commercial and Industrial Fair held through the initiative of Mr. Arsenio Luz, Director-General and Mr. Geo. L. Logan, Honorary Secretary of the Philippine Carnival Association. The Philippine Government was represented by nine bureaus and offices. A number of the provinces had booths as well as some of the commercial firms.

As a whole the Commercial and Industrial Fair, in spite of the limited time allowed for its preparation, proved a success, the products displayed at the different booths being of great interest as they showed the vast agricultural and commercial possibilities of the Philippines. Hereunder follows a brief description of each booth:

GOVERNMENT PARTICIPATION

BUREAU OF SCIENCE

The Bureau of Science exhibit graphically illustrated actual annual production of gold in the Philippine Islands since 1907; samples of coals, rocks, ores and minerals, turtles, fishes, and other marine specimens; bricks, clays, limestone, and other industrial products; mounted birds of the Philippines and tanned skins of various animals; specimens of oils, fats, and waxes found in the Philippine Islands; products for the treatment of leprosy from the crude seeds of the finished preparation for injection to the leper patients; and the manufacture of tiki-tiki extract showing the various raw materials and finished product. It also included a complete set of photographs showing the different possibilities for the Philippine products.

BUREAU OF EDUCATION

The Bureau of Education industrial exhibit occupied six booths in the main building.

It consisted of articles of many original designs and of nearly all the standard Bureau of Education designs made in the public schools this year. It consisted of embroidery, Irish crochet, Valenciennes lace, Cluny lace, garments made in plain-sewing classes, and such handwoven products as baskets, mats, and hats.

Each evening there were as a part of the exhibit, actual demonstrations of work in embroidery, lace making, and handweaving.

To practically every article was attached a tag bearing the maker's name, address, age, and grade, and the number of hours it took to make the article. This information added to the instructive value of the exhibit.

Most of the work on the articles exhibited was done by pupils between the ages of ten and seventeen.

The handwoven articles were all made of native materials obtained from a number of varieties of palms, grasses, ferns, vines, and parasitic plants.

BUREAU OF COMMERCE AND INDUSTRY

The Bureau of Commerce and Industry participation at the Commercial and Industrial Fair covered a great number of the commercial and industrial activities of the Islands. A display of locally manufactured products such as hats of various kinds, embroidery, mats, cloths, etc., was a popular feature of the exhibit; and still more interesting were the booths of artisans at work to demonstrate the actual method of manufacturing them.

There were also specimens of the principal agricultural products such as hemp, tobacco, sugar, etc., mineral products such as crude oil, ore, coal, gold, etc., forest products which covered rubber, gutta-percha, almaciga, lumber, etc., sea products such as fish, sponge, shells, etc., and others having commercial and industrial importance.

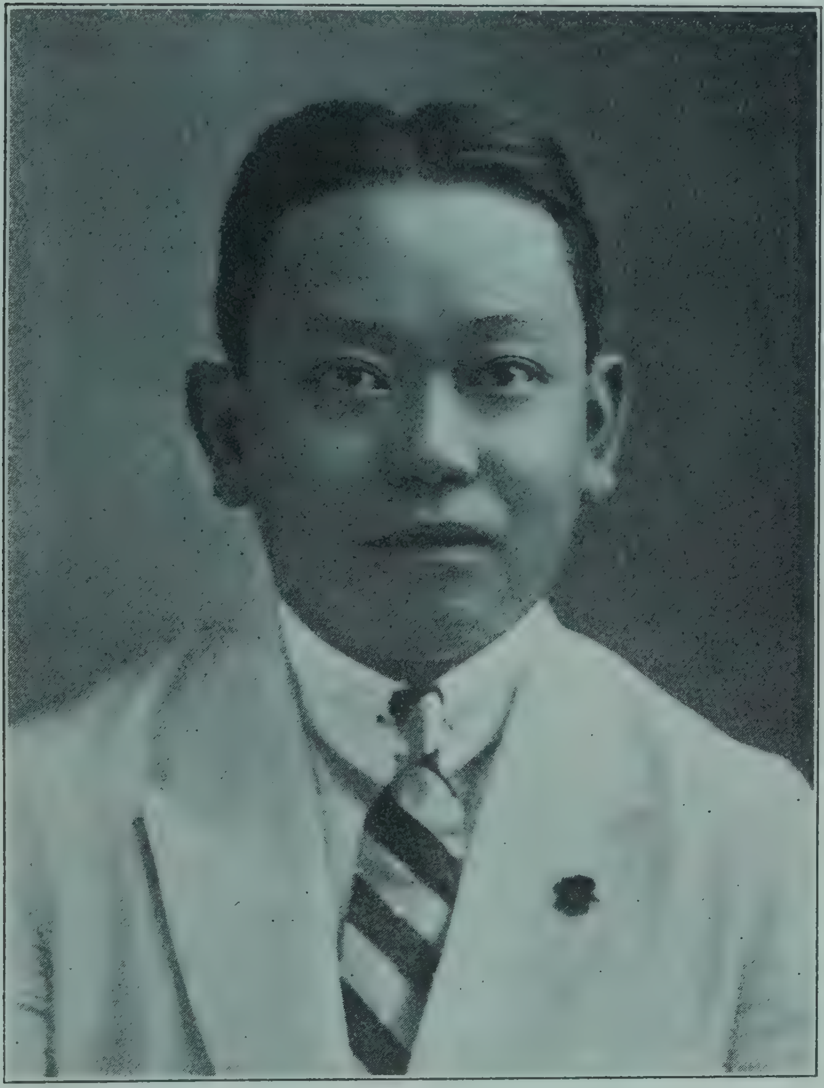
Statistical charts depicting commercial and industrial possibilities in the Islands were displayed together with other charts showing the volume of trade of the Philippines and its distribution.

Engineer Island sent a revolving light such as the lighthouses in Philippine waters are equipped with as a part of its exhibit.

PHILIPPINE HEALTH SERVICE

The Philippine Health Service booth gave Manila Carnival visitors an idea of the wide scope of its various activities and an opportunity to see the different means to make a home and its surroundings sanitary. Familiar talks on tropical diseases were given.

Different diagrams, cartoons, and frames were combined in the exterior decoration of the booth, showing disease carrying germs and insect and intestinal parasites. There was also an exhibit of sanitary plumbing and posters to illustrate the results



ARSENIO LUZ

Director General of the Philippine Carnival to whose efforts the success of the Commercial and Industrial Fair was mostly due.

(*a*) Main grand entrance of the Carnival City, 1922

(*b*) Spacious entrance to the Commercial and Industrial Fair

of ignorance of hygiene, and general sanitation and the activities of the Philippine Health Service.

Within was a miniature lighthouse tower with transparent potographs of sanitary and insanitary barrios; the model of an artesian well; sanitary model houses (one complete and one under construction); water demonstration by means of the microscope; practical demonstration of vaccination; pictures of bathroom equipment; athletic goods display; toilet articles; food and drink display; a child showing effects of vaccination; a model public bath and toilet rooms; apparatus and other implements to catch flies and rats; diagram showing general morbidity, mortality, and birth rates; public midden sheds, Culion Leper Colony; forms used and bulletins issued by the Philippine Health Service; health decalogue; diagram showing the growth of the Philippine Health Service in personnel; map of the Philippine Islands showing different health districts, sanitary divisions, hospitals, and dispensaries; goddess of hygiene; Pasteur's antirabic vaccine, etc.

BUREAU OF PRISONS

The departments which were represented were the furniture manufacturing Departments "B" and "D" of the Industrial Division of Bilibid Prison.

The products of Department "B" were made from selected Philippine lumber, air seasoned and kiln dried. It is this department which specializes in the manufacture of all classes of household and office furniture in plain and special carved designs. As representative of the work performed, a complete bed room set, a dining room set, and parlor set, in addition to miscellaneous articles finished in dark mahogany and natural color showing the grain of selected native woods, were on exhibit.

The activities of Department "D" were represented by rattan products manufactured in this division. These items included woven hemp hammocks, rattan chairs in a large number of designs ranging from ordinary straight back chairs to the special peacock style adopted for veranda sanitation and numerous articles of useful and handsome household furniture, some of the more attractive being combinations of hardwood and rattan.

BUREAU OF PUBLIC WORKS

The exhibit of the Bureau of Public Works in the Main Exposition Building of the Manila Carnival consisted of the following:

Models of the Angat River irrigation system, Bulacan Province, which is under construction, and the proposed capitol buildings

and grounds, Government center, Manila; maps of the Philippine Islands showing completed and proposed roads, Government irrigation projects and towns supplied with water works systems and successful artesian wells; diagrams illustrating activities of the Bureau of Public Works and the effect of automobile traffic on the cost of road maintenance; drawings showing the front elevation of the insular building, post office, and custom house, which are under construction and the proposed monument to Andres Bonifacio; plans showing proposed development of Manila harbor, Pier 7, and proposed development of grounds adjoining new post office and Jones Bridge; sketches giving statistics on the construction of roads, bridges, culverts, market buildings, presidencias, schoolhouses and hospitals in the Philippine Islands; miscellaneous photographs of roads, bridges, buildings, piers, lighthouses, dams and other irrigation structures.

BUREAU OF FORESTRY

The exhibition of this Bureau gave the Carnival visitors a complete idea of the tremendous wealth and possibilities of our forests. Samples of the principal and minor forest products of the Philippines were displayed, such as planks, almaciga, rattan, etc. The advantages of forest conservation was graphically illustrated.

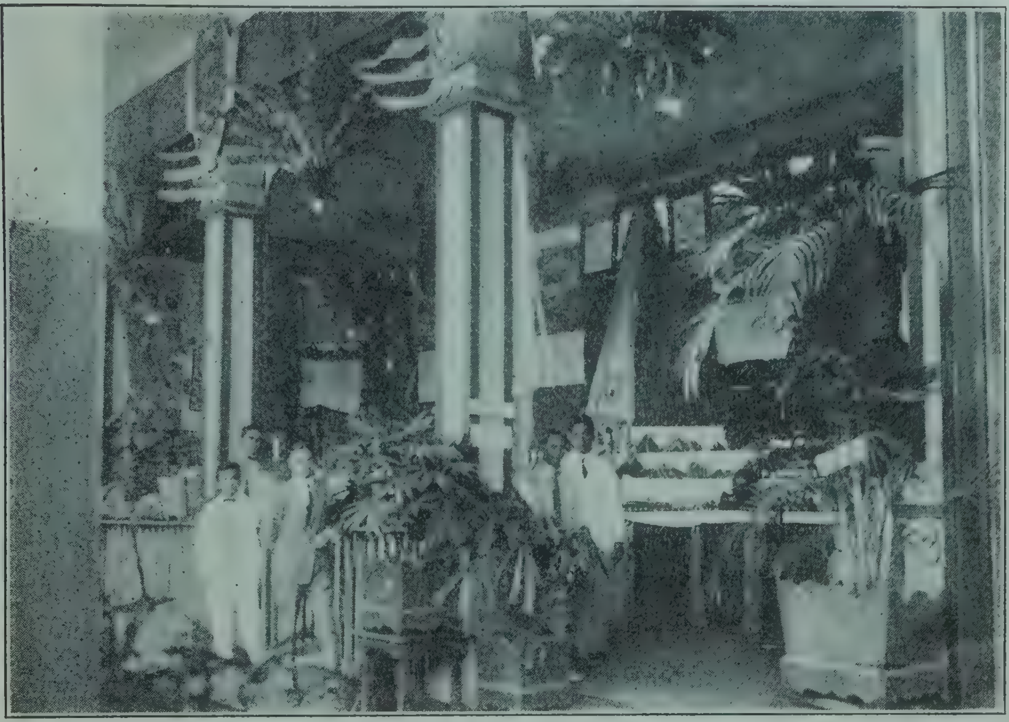
BUREAU OF AGRICULTURE

The Bureau of Agriculture for the 1922 Commercial and Industrial Fair occupied four adjoining 3 x 5-meter booths and displayed different agricultural products of the Islands to show the results of proper farming methods. Improved varieties of corn and rice were displayed and the increase in yield illustrated. Different varieties of root crops, nuts and fruits of the introduced plants grown in the experiment stations were also displayed.

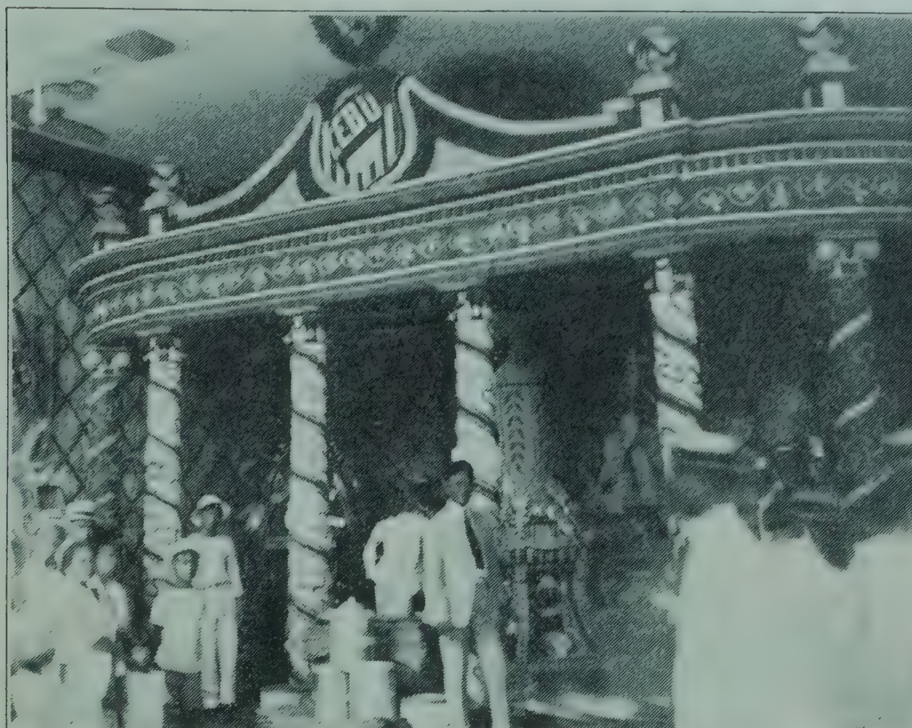
The importance of seed selection and the right methods of planting to increase production were emphasized by exhibiting products resulting from the coöperative trial plantings and the experiments carried on in the different stations of the Bureau.

Statistical chart and graphic comparisons of the yearly production of the most important crops were on view. Some antiquated plows, harrows, etc., were shown side by side with modern ones to show the improvement made in these implements.

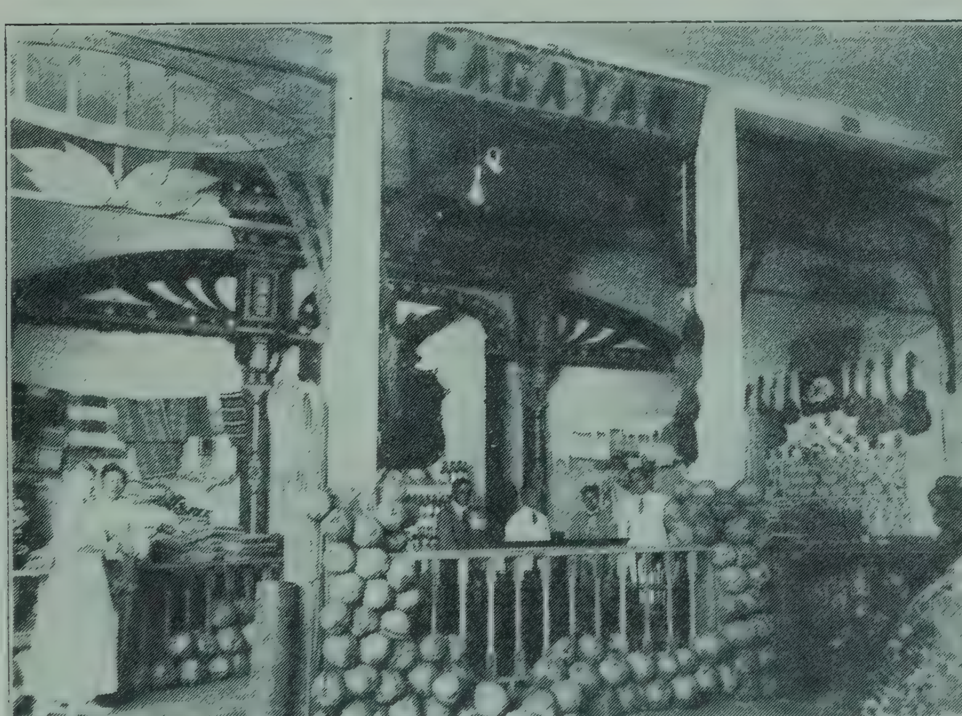
Cases of insect pests and plants showing the effects of diseases on various crops were on display also and methods of combating plant enemies were indicated by apparatus and photos.



Views of the Bureau of Agriculture booth, Commercial and Industrial Fair, Philippine Carnival, 1922



(*a*) Cebu booth, the most beautiful of all the provincial booths



(*b*) Cagayan booth, which captured several prizes for its rich exhibit

There was a fine exihibit of plants showing the various methods of vegetative propagation, such as budding, grafting, layering, marcottage, etc., and practical demonstrations of these methods were given every afternoon. (*See* Plate IX.)

PROVINCIAL PARTICIPATION

CEBU

Cebu was represented by a latticed arbor of maguey, sugar cane and tobacco, interwoven with blossoms fashioned of corn on the ear. The roof was supported by tobacco columns. Within the arbor were samples of local products including cakes and candies made of peanuts, rice, coconut and other foods, a settee made entirely from corn, guitars made out of coconut shells, and a maize figure fashioned in the form of a miniature carabao. (*See* Plate X *a*.)

CAGAYAN

Tobacco comprised the major portion of the Cagayan exhibit. The entrance, elaborately designed, was entirely of tobacco, as was the Philippine coat of arms, prominently displayed. Two one-piece tables each 3 meters in diameter handsomely carved furniture, musical instruments, specimens of wheat, millet, rice and coconuts, biscuits and different kinds of wine were shown. Cigars were distributed free. (*See* Plate X *b*.)

TAYABAS

The outer walls of the Tayabas booth were imitation cobblestones of coconut husks held together with gilded mortar. The inner walls were of rice on which were painted charming tropical scenes. The booth valuables were stowed away in a copra safe, over which hung a relief map of the province. (*See* Plate XI *a*.)

LAGUNA

Laguna displayed a bust of Rizal made of Laguna cheese. A realistic waterfall, and wood carvings including a bust of Governor Wood, were other features of the exhibit. Outside the booth there was some exquisitely carved furniture. (*See* Plate XI *b*.)

PAMPANGA

The entire Pampanga booth was made of rice. Its outstanding feature was a statue of Mercury, and in the background a mountain landscape of sugar and cereals. Within the booth were samples of local products including hemp, embroideries,

fish, distilled liquors, cigarettes, shoes, mattresses, lanate wood furniture, and the model of a new piece of combination furniture designed by Rafael Velos, of Guagua, entitled the "Three in One," convertible in turn into a bed, a desk, and a wardrobe.

PALAWAN

Palawan displayed its products from a gallery reached by two flights of stairs, one on each side of the booth, each step decorated with articles made of shells and polished wood. Downstairs was a reproduction of the mouth of the famous subterranean river, with a small boat in the act of embarking on its underground journey.

TARLAC

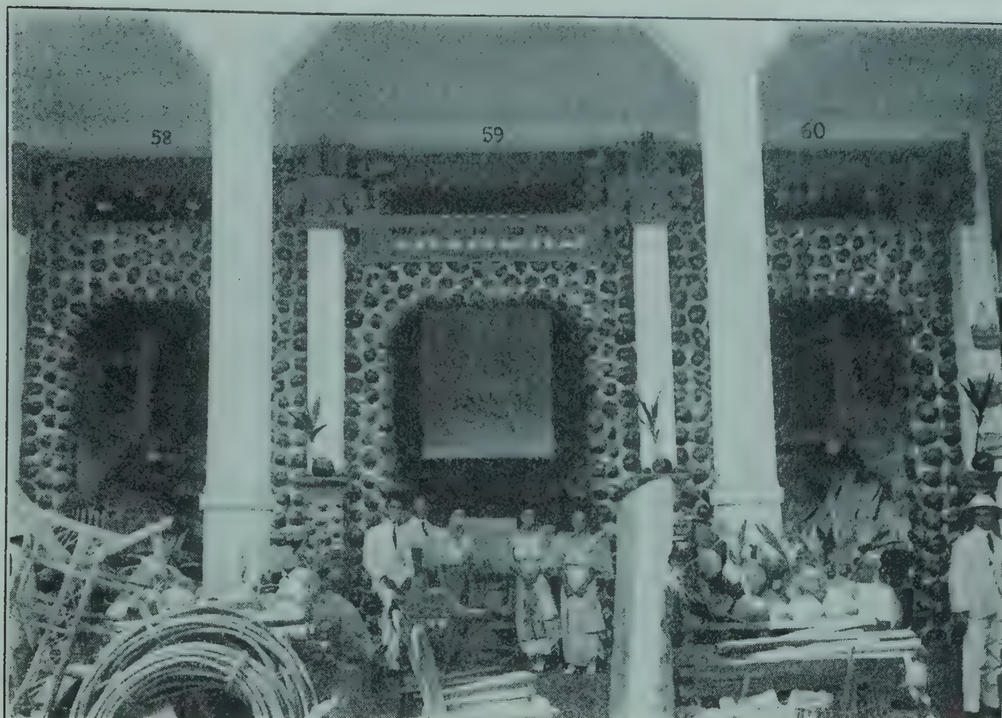
A feature of the Tarlac exhibit was the Tarlac irrigation system in miniature. Rice and other agricultural products were displayed.

LEYTE

Leyte had a view of Tacloban, the capital of the province, around which was a rich display of raw hemp and its finished products such as ropes, cloth, etc. There were also beautiful mats decorated with coats of arm and pictures of prominent men.

RIZAL

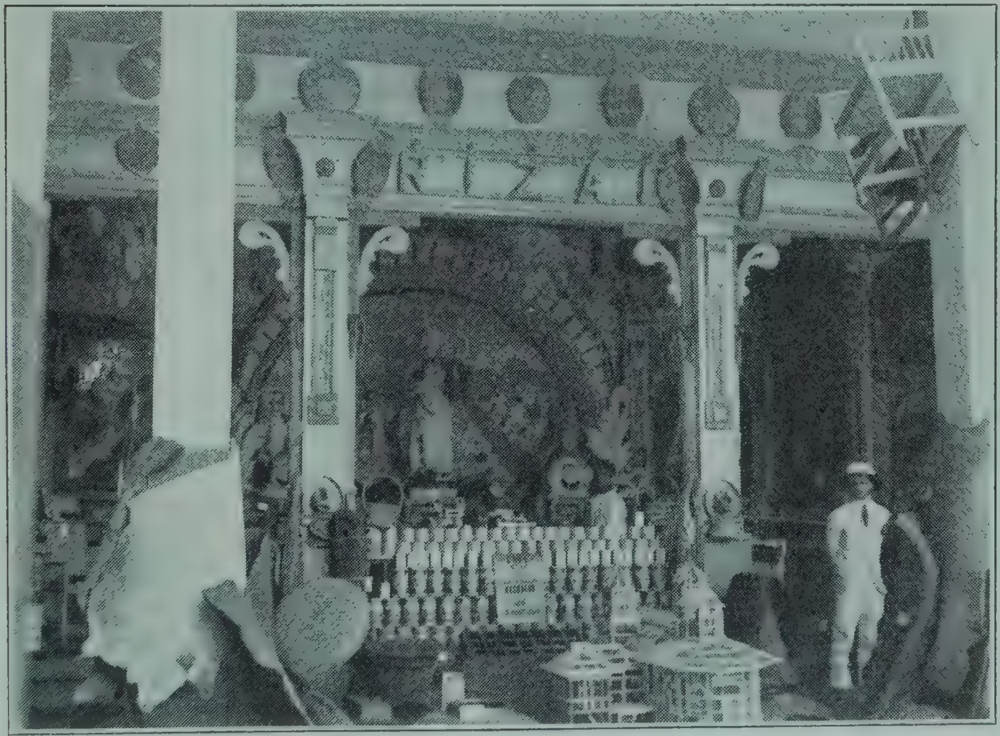
Rizal had a number of very good paintings of typical provincial scenes including women at their tasks of weaving, hat making, the rice paddies, and fishing. There were also some canned food. (*See* Plate XII *b*.)



(*a*) Tayabas booth, noted for its coconut display

(*b*) Laguna booth attracted attention for its well arranged display of agricultural and industrial products

(*a*) Pampanga with its exhibits of sugar, palay, fisheries and furniture made an artistic booth which was admired by the public



(*b*) Rizal booth with its industrial and commercial products made a good showing

APPENDIX

BIBLIOGRAFÍA AGRÍCOLA FILIPINA PRECEDIDA DE UNA RESEÑA HISTÓRICA

Por MANUEL ARTIGAS Y CUERVA, *Bibliotecario de la "Philippine Library and Museum"*

LÍNEAS PREFACIALES

Es una verdad a todas luces indiscutible, que el suelo filipino es el venero de riqueza mayor que posee el país, y por tanto, su principal fuente para levantarlo a un status halagüeño, cuando nuestra agricultura rinda todo cuanto de ella hay que esperar, a medida que los modernos sistemas de laboreo vayan vulgarizándose en nuestras Islas.

Su estudio ofrece ancho campo a los interesados en conocer cuanto se ha escrito sobre este particular, y en esta época de febril actividad, más que en ninguna otra, es preciso acudir con trabajos que faciliten cuantas investigaciones sean precisas para el desarrollo de nuestro suelo.

Pensando en esa necesidad y en la creencia de que una labor enderezada a ese fin, podría ser útil, nos ha parecido ofrecer esta BIBLIOGRAFÍA a la Oficina de Agricultura, estableciendo el orden alfabético de autores en la redacción de las papeletas, si bien luego en el índice por materias, se pondrá especial cuidado para que cualquier informe pueda hallarse con la menor pérdida posible de tiempo.

Creemos sinceramente que con el entusiasmo digno del mayor encomio que viene prevaleciendo en lo que hace a este ramo, cualquier trabajo dedicado a cooperar, aun cuando en pequeña escala, a cuanto se viene realizando, ha de despertar cierto interés entre los amantes a esta clase de estudios.

Fundados, pues, en ese pensar, no hemos titubeado en lanzar a la publicidad esta BIBLIOGRAFÍA, sólo con el propósito de poder ser útiles a nuestros semejantes.

RESEÑA HISTÓRICA

La agricultura, como ha dicho alguien, es la ciencia primitiva y privilegiada del hombre, la ocupación más sencilla, noble, y más digna; es la base y principal fundamento de las riquezas de toda sociedad. Ella es, pues, el origen y manantial de la riqueza pública y el más firme apoyo de los Estados, y variando y extendiendo las producciones particulares de su suelo, las derrama en el comercio, y de aquí, el interés que despierta todo cuanto atañe a la misma en nuestro país, y justo es, que consagremos a tan importante ramo nuestro tiempo, dando a conocer lo que fué y lo que es, para deducir la suerte que la deparará en el mañana.

Se ha dicho, se propalaba y hasta se aseguró con visos de la mayor sinceridad, que la desidia por un lado, el desconocimiento por otro, y la carencia, por tanto, de una educación adecuada en materia agrícola,

nos ha traído a una situación tan poco lisonjera, como la que hasta ahora existe, sin parar mientes en lo que se ha verificado, sin la menor consideración a cuantos trabajos se realizaron en pró de nuestra principal fuente de riqueza pública.

Tal estado de cosas, acusaría en el hijo del país una falta intolerable, aparte de ser ello causa bastante para buscar un nuevo argumento con que engrosar ese ejército de razonamientos que con una constancia espartana, han venido sacándose a luz, para deducir de aquí, una falta de civilización que ocasiona pérdida de ciertos derechos concedidos a los países que ostentan su nacionalidad, aún cuando de hecho, en muchos respectos pudiéramos invocar faltas y actos que desdicen de países a quienes se denomina civilizados.

No ha permanecido, por fortuna para nosotros, esta hermosa tierra que nos vió nacer, tan atrasada en cuanto a los medios agriculturales, siendo de ello buena prueba, que cuando Legazpi llegó a Kabalian el 5 de marzo de 1565, descubrió muchas sementeras de arroz y mijo, con gran número de palmeras y plátanos, pero es más, aquel insigne adelantado manifestó en una de sus memorias al soberano de España, que los naturales del país poseían en sitios retirados y a cubierto de las depredaciones de la morisma, terrenos que cultivaban, cuyos productos pasaban a ser de la propiedad de los jefes de cada barangay, quienes concertaban un sistema de aparcería, si los trabajos se verificaban por las familias libres.

Había, como se ve, una base espléndida, sobre la cual se podía impulsar esa fuente de riqueza, y no es raro que el P. Plasencia en su célebre informe fechado en Nagkarlang el 24 de octubre de 1589 acerca de *Las costumbres de los indios tagalos de Filipinas*, se expresara así: "Las tierras donde poblaron las repartieron en todo el barangay, y así conocía cada uno de cada barangay las suyas, en particular la que es de regadío; y ninguno de otro barangay labraba en ellas si no se las compraba o heredándolas. En los tingues o serranías no las tienen partidas, sino sólo por barangayes, y así como sea de aquel barangay, aunque haya venido de otro pueblo cualquiera, como haya cogido el arroz quien comienza arrozar una tierra la siembra y no se la puede quitar. Otros pueblos hay, como Pila de La Laguna, en que pagaban estos Maharlikas al Dato cada uno cien gantas de arroz, mas esto era porque cuando vinieron allí a poblar, tenía ya tierras otro principal ocupadas, y compróselas, el que de nuevo vino, con su oro; y así los de su barangay le pagaban este terrazgo y repartía las tierras a quien quería. Agora, después que hay españoles no se lo dan."

Y otro escritor de los primeros años de la dominación hispana, Don Miguel Loarca, refiriéndose a la labor verificada en estos pueblos, dice que tenían siete días para labrar sus tierras.

Había, pues, terreno abonado para construir sobre aquella hermosa cimentación que hallaron los primeros pobladores hispanos, pero se hizo algo más que todo eso: las leyes constantemente marcaban el interés que en la Metrópoli y en el mismo país existía para el desarrollo del ramo agrícola, dictándose muy oportunas recomendaciones por las leyes de Indias, que luego fueron enmandadas por otras prescripciones hijas de la experiencia recogida y de profundos estudios.

En el siglo XVII, siguiente a la conquista por España de estas fértiles tierras, hombres estudiosos trataron de lo mucho que atesoraba el terreno

filipino, y se contaron entusiasmos plausibles entre algunos gobernadores generales, como Basco de Vargas, que dedicaba con preferencia su atención a tan útil y beneficioso ramo público.

Sobre la esplendente base que en nuestras Islas halló el gobierno español cuando aquí implantó su dominación, se trabajó a contar desde los primeros tiempos, y así se ve que ya en 6 de abril de 1588 se advierte que no se repartan tierras con agravio de los naturales, lo cual se repitió en 11 de junio de 1594, añadiendo que las tierras dadas se devuelvan, y luego, en 11 de junio de 1612, se manda sacar los ganados de las tierras de regadío, disponiéndose que éstas se siembren de trigo.

Indudablemente los nuevos dominadores con el ansia de adquirir propiedades, debieron proceder en forma no muy correcta, cuando en 30 de junio de 1916 la Ley 17, título 12, dice: "Que no se admita a composición de tierra que hubiere sido de los indios o con título vicioso; y los fiscales y protectores sigan su justicia."

Allá en el siglo XVIII se dicta en 6 de octubre de 1759 la real orden obligando a cada filipino a sembrar anualmente diez pies de coco, cacao, bonga o pimienta, mandándose en 26 de febrero de 1768, que, los naturales siembren un número determinado de árboles útiles para cada pueblo, así como también trigo, arroz, maíz, legumbres, pimienta y otros vegetales análogos, obligando al propio tiempo a que cada uno tenga por lo menos doce gallinas, un gallo y una lechona de vientre. Y por si esto fuera poco, la exigencia de las autoridades llegó en esa misma fecha a ordenar que los filipinos ricos tuvieran 200 pies de abacá y otros 200 de coco, y el pobre la mitad de uno y otro.

Para promover el desarrollo agrícola, en 12 de enero de 1777 se disponía que los naturales se dedicaran a la siembra, cultivo y beneficio del lino y cáñamo, cuya introducción en España se declaraba libre de derechos.

Pero cuando se tomó verdadero empeño en esta fuente de riqueza pública, fué a contar desde el arribo a estas Islas en julio de 1778 del gobernador don José Basco y Vargas, que venía precedido de fama por su ilustración y actividad, propia de un ciudadano joven, como lo era, y así se ve que en 1.° de septiembre de 1779 se expresa en esta forma:

"* * * Si del comercio se reconoce, como es regular, por su verdadero manantial a la agricultura y a la industria, no cabe duda sino que a sus directores toca el que procuren averiguar si en nuestra tierra se halla este manantial, de donde se abastezcan copiosamente su comercio interior y exterior."

De acuerdo con esos principios que sentara, dictó en 20 de marzo de 1780 reglas para el plantío, cultivo y beneficio de la pimienta, ocupándose después en igual fecha del año siguiente, en hacer pública la forma de coger este producto, vulgarizar su cultivo y tener presente las primas que para ello ofrecía el Tribunal del Consulado.

Obedece a ese mismo plan su interés por establecer la Sociedad Económica, en cuyos Estatutos aprobados en 20 de abril de 1781, hablando de la labor encomendada a la Comisión que se formó para dedicarse al estudio de la agricultura y economía rústica, se prevenía que se dedicara a tomar noticias ciertas de la naturaleza de los terrenos de las Islas, y de los granos, semillas y variedades de plantaciones en que se emplean o pueden ser empleados con mayor utilidad, como también de los tiempos y métodos de las labores del campo, según la condición de las siembras, de las plantaciones y cosechas, observando la razón en que éstas acuden.

También se disponía que se enterara de las plagas a que todo género de siembra y plantío está sujeto, y de los defectos que se padecen en la agricultura y economía rústica, discurriendo los mejores medios de precaverlos o sanarlos, a fin de que las obras rústicas logren con mayor seguridad sus producciones, contrayéndose principalmente al trigo, arroz, cacao, tabaco, moreras, canela, pimienta, clavo, añil, bonga, cocos y todo género de palmas.

Trabajaba Basco y Vargas por el levantamiento agrícola del país, y de ello es buena prueba cómo alentaba al conceder en 1783 varios premios en metálico a los que justificaran haber cogido de propia cosecha mayor porción de pimienta y de algodón, así como al que presentase las mejores muestras del añil flor como el de Guatemala, invitando a los hijos del país en bando expedido desde Arayat el 20 de marzo de 1781, para que se dedicaran al cultivo de los campos.

En años sucesivos desde 1785 hasta terminar esa centuria, vénse disposiciones, todas ellas encaminadas a dar vida a nuestras tierras, como las instrucciones dictadas para el cultivo de la morera y cría de gusanos, ofreciendo tanto plantas como gusanos, abonándose por las cajas de comunidad los gastos que produjera la estancia de dos personas de cada pueblo que vinieran a la capital para aprender; otra instrucción para el beneficio de la canela y nuez moscada, y una real orden que declara sean libres de derechos a su entrada en Acapulco los productos filipinos.

Como base de un futuro halagador, las disposiciones adoptadas desde 1588 hasta terminar el siglo XVIII, no pueden ser más apreciables, y la exuberante riqueza de nuestro suelo no hubiera permanecido con lo que se hizo en el siglo XIX, en el status en que le encontró el XX, si cuantas órdenes se dieron, hubieran sido puestas en práctica con mayor sinceridad, sobre todo, desde el segundo tercio de la fenecida centuria.

No es la primera vez que nos vemos forzados a estampar el nombre del gobernador Basco de Vargas, cuyo celo en pró de nuestras fuentes de riqueza no llegó a superar ninguno de los ejecutivos hispanos, pero su labor fué tan plausible en lo que hace a dar impulso a la agricultura, que constituyó en él la base de su programa de gobierno, y es difícil sino imposible, referirse a lo realizado acerca de este vital servicio, sin mentar aquella personalidad.

Aquel entusiasmo del gobernador Basco cuando en 1781 se estableció la Sociedad Económica, le llevó a procurar cuanto entendía beneficioso para levantar la agricultura y sus grandes conocimientos le sirvieron de mucho en su afán de realizar los nobilísimos intentos que poseyera. Sabíase por ejemplo que desde las más remotísimas épocas China era la patria de la seda pasando de allí a la India y a la Persia, donde sufrió un paro de algunas centurias, hasta que pasó a Roma en la época de los Lúculos y Pompeyos con precios elevadísimos, que hacían imposible su adquisición, no habiéndola usado en aquel imperio hasta pasado algún tiempo, en que el emperador Heliogábalo inauguró la moda de vestirse con trajes de seda.

Conocido histórica y mercantilmente lo valioso de aquel producto, al poco de llegar Basco a las Islas, allá en 1781, encargó al religioso agustino P. Galiano que enviara moreras y se plantaron alrededor del Colegio de San José grandes extensiones de este árbol que crecía con facilidad produciendo abundante cosecha de una seda superior a la recogida en Europa.

Alentados los vecinos de Manila con lo que habían visto, hubo gran entusiasmo, sobre todo, al notar que los gusanos procreaban bien y se

hallaban en disposición de producir seda durante todo el año, de tal manera, que en ese lapso de tiempo se recogían nueve cosechas, vislumbrándose además que podrían ofrecerse mayores ventajas si se ponía más cuidado.

Lo cierto es que la morera se hizo de moda, y aparte de las grandes extensiones del Colegio de San José y de que hemos hecho mención, así como de otros sitios, en Parañaque solo, pudieron contarse 2,750 pies de moreras que venían a ser una variedad de la morera blanca, y en 1821 Samuel Perrotel la exportó a Europa.

Desgraciadamente, sea por falta de brazos como algunos han aseverado, o fuese por otras causas, es lo cierto que hubo de ser abandonada esa siembra, pero no hasta allá a mediados del siglo XIX, pues de 1841 a 1843 se dieron a la estampa tres trabajos de los Sres. José Echegaray, Francisco Monfort y J. M. Rosi, acerca del cultivo y plantación de la morera en estas Islas; así como de la cría del gusano de la seda y mejora de la industria de ésta, lo cual prueba que hasta entonces, aun se creyó que podía continuar produciendo aquélla.

Hemos hablado ya de cuanto se hizo en el siglo XVIII en pró de la agricultura, pero para completar el cuadro, vamos a mencionar el bando dictado por Basco de Vargas en 29 de octubre de 1782 dando instrucciones sobre la compra-venta de carabaos, y en el que, explicando su pensar, decía: "La decadencia que de día en día padece la agricultura, a causa de los muchos robos y muertes de carabaos que se experimentan, única especie de animales con que el labrador se maneja, reduciría sin duda las Islas al más deplorable estado, si no se aplicasen a contener este mal los más activos remedios. Y si en todos tiempos debe sostenerse la agricultura, por ser la que con sus productos socorre las primeras y más urgentes necesidades de la vida, hoy que nos debe proveer también de las primeras materias, sobre que han de ejercitarse las artes y la industria, de cuyo establecimiento se trata, hácese más indispensable esta providencia."

Pocos años después, allá en 30 de julio de 1780 y atraído por los informes que en extrañas tierras se tuvieran de la riqueza de nuestros campos, llegó a Manila acompañado de una Comisión científica, el insigne naturalista Don Antonio Pineda, con el propósito de estudiar la Flora de estas Islas y su situación agrícola, pero no llegó a realizar su plan completamente, por haber fallecido en 1792, y para rememorarlo, se dió el nombre de Pineda a uno de los pueblos de Manila y que hoy pertenece a la provincia de Rizal. Con todo, era significativo el envío de esa Comisión encabezada por profesionales de renombre, y que suponía el conocimiento que se tenía de nuestra exuberante Flora fuera del país.

De tal manera se había propagado ese conocimiento en otras partes, que uno de los gobernadores generales más caballerosos que aquí vinieron, don Rafael María de Aguilar Ponce de León, a los cuatro meses escasos de llegar, en diciembre de 1793, exteriorizó su entusiasmo manifestando que el fomento de la agricultura dependía en gran parte de la exportación de frutos, y esto se verificaba ya, porque los extranjeros pagaban grandes cantidades en plata efectiva, pues como lo que extraían era más de lo que introducían, resultaba la balanza en favor de las Islas, y añadía que él estaba seguro de que ese interés real y verdadero que conocía ya el filipino, le movería de tal modo, que el año 96 se extraerían frutos por valor de dos millones y medio de pesos fuertes, y mucha mayor cantidad aun, en años siguientes.

No queremos entrar en lo hecho en el siglo XIX sin dejar consignado todo lo que se conoce con anterioridad a esa fecha, y bueno será expresar que antes de 1626, ya el religioso recoleto Fr. Rodrigo de Aganduru Moriz, escribía un *Manual de Medicinas Caseras*, todas de plantas del país.

Al terminar con la labor realizada en el siglo XVIII, labor que necesariamente había de servir, como la realizada en anteriores centurias, de vanguardia para los esfuerzos que luego después se determinaran, es indudable que en todo ese empeño, en ese trabajar progresivo, teníamos que ver a la fuerza, porque las circunstancias así lo exigen, un beneficio, y no pequeño, que se hacía al país, tanto más, cuanto que dada la fertilidad de su terreno, cualquier ensayo ofrece resultados apetecibles.

Responde a eso la propaganda que al menos en esta materia, significaba esa labor, siendo de ello, entre otras cosas, una buena prueba que alienta y fortifica a cuantos sienten cariño por nuestras cosas, el hecho de que al principio del siglo XIX Agustín Pedro Blaquier, escribiera una muy importante obra con curiosísimas noticias acerca de las especies del reino vegetal que se crían en las Islas Visayas, con especialidad en las provincias de Sugbu e Isla de Negros, así como en las de Sámar y Leyte, donde se había dedicado a hervorizar durante el tiempo que administraba las parroquias de esas localidades.

Luego vemos que en 1811, al amanecer como quien dice de esa centuria, llamada de las luces, un estudioso ciudadano, Don Mariano Lagasca, en su libro editado en Orihuela *Amenidades Naturales de las Españas*, ya habla y enumera plantas de Filipinas connaturalizadas en aquella antigua metrópoli, es decir, por entonces llamaba ya la atención, indudablemente, la riqueza de nuestro suelo, con todo de no haber sido en esas fechas lo suficientemente explorado.

Aun cuando los comienzos del siglo XIX se caracterizaron en estas Islas por atraer la atención pública en cuestiones que afectaban a la política, tales como movimientos revolucionarios, medidas sobre respresentación en Cortes, etc., sin embargo, la agricultura encontró apoyo, dictándose en 7 de diciembre de 1801 una real orden que prevenía se fomentara aquélla, así como las industrias de las Islas, y en 22 de abril de 1804 se solicitó de la autoridad superior del país, un informe acerca de la conveniencia de proteger la agricultura, declarando libres de derechos de alcabalas y diezmos, tanto el algodón, como el café y el añil.

Tratábase de tres productos que tenían especial importancia, no sólo por el beneficio que reportarían bajo el punto de vista comercial, sino porque se producían en esta parte del mundo.

Si nos fijamos en el algodón que desde luego es originario del oriente, conocíasele ya en muy remotos tiempos en la India, como que desde tres siglos antes de Jesucristo escribió Teofrasto acerca de él, y sólo en la edad media fué conocido en Europa, y desde el siglo XIII se confeccionaron tejidos en Venecia.

En Filipinas se cría el algodón a contar desde la época prehispana, pues cuando vino el adelantado Magallanes y los suyos, los hijos del país usaban trajes de tejidos, y con artefactos, si se quiere primitivos, ya fabricaban entonces.

Las dos especies de algodoneros que se crían en Filipinas, no sólo son superiores sus productos a los de Bombay, sino acaso a los de cualquier otro sitio donde se cultive, y aquí se teje principalmente en las provincias de Ilocos y Batangas, aun cuando en las demás también se dedican a esa industria, y en ocasiones se mezcla con seda, piña, o con el abacá,

haciéndose ropas tan finísimas, que un crítico de la Exposición de 1887 refiriéndose a nuestros tejidos, manifestó que no los repugnaría la más acreditada fábrica de Malinas o de Belfast, y actualmente se realiza una muy apreciable exportación de ellos.

Conocida la importancia del algodón, se trató por todos los medios de dar impulso a su cultivo, y aparte de otras medidas de antiguo adaptadas, vemos que en 23 de abril de 1836 se dispone la remisión a Antike de semillas de Pernambuco para que se siembren, y en su afán de impulsar más y más este producto, se trató en 3 de febrero de 1838, de abrir el puerto de Manila a los algodones extranjeros.

Cuando el gobernador Lemery allá en 1861 se ocupó de la administración de las Islas, tuvo decidido empeño en el cultivo del algodón, y en 4 de diciembre de ese año, se recomienda su siembra, para la que se dieron detalles hablando del beneficio que producía, y luego, en 21 de febrero de 1862, se declara libre de derechos la siembra, introducción de semillas útiles, y de los aparatos destinados a la siembra y beneficio, al par que se ordenaba la concesión de premios en medallas o en otra forma, a los hacenderos que presenten mayor extensión de cultivo y mejor calidad del fruto.

Por otra parte, de nuestro algodón se vienen ocupando desde tiempos muy antiguos escritores extranjeros, pudiéndose citar al que fué factor general de la Compañía de Filipinas don Tomás Comyn, quien al dar a luz en 1820 y fechado en Madrid, su importante libro *Estado de las Islas Filipinas en 1810*, expresa que el algodón producido en Filipinas, es de los mejores del mundo, y luego, en febrero de 1855, un distinguido médico, el Dr. José Martín Martínez, trata con un conocimiento grande este producto, en su *Memoria sobre el cultivo, industria y comercio del algodón en Filipinas*, insistiendo años después, allá en 1895, acerca de la importancia del arroz, en su notable revista quincenal *La Vida Industrial en Filipinas.*

Si nos referimos al café, cuyo nombre parece haberse tomado de Kaffa, sitio donde crece, y que desde el siglo XV nada más comenzó a propagarse, viéndosele ya en el XVIII en la Martinica, Santo Domingo, Guadalupe, Cayena, Guayana francesa, Isla de Reunión y Jamaica, no habiéndose introducido en Cuba hasta 1748, llevado por don Juan Antonio Gelabert, que hizo las primeras siembras en tierras del Najay, sabemos que allá a fines del siglo XVIII podían contemplarse algunas, muy pocas plantas de él, en aquel ensayo de Jardín Botánico que entonces había en Manila, siendo luego transportado a La Laguna, y de aquí a otras provincias, propagándose con cierta facilidad, porque es admirablemente fértil, crece en cualquier lugar donde se deje caer el grano, y se da espontáneamente en muchas de nuestras montañas, ofreciendo por lo general, un grano de superior calidad.

Donde en verdad hizo progresos este cultivo, fué en Batangas, donde en 1808 apenas si se contaban en los huertos algunos de estos árboles, pero luego el Sr. Galleo Reyes que durante los años 1812 a 1825 fué gobernadorcillo de Lipa, tomó con empeño la propagación del café y lo consiguió, decayendo algo ese entusiasmo, aún cuando luego renacieron actividades a las que contribuyó no poco la Sociedad Económica, que en su afán de generalizar en las Islas el plantío de este producto, entre otras cosas, reimprimió en 1827 la *Memoria sobre el cultivo del café en la Isla de Cuba.*

Cuando en 1832 el Sr. Santiago Reyes, hijo de don Galleo, fué elegido gobernadorcillo de Lipa, continuó la labor de su señor padre, y extendió el área de este cultivo que se hacía en gran escala en 1859.

Un prominente hijo de Batangas, el Sr. José Luz, fué uno de los entusiastas por el café, desarrollando tales actividades para dar a conocer lo valioso de esta producción, que reunió apreciabilísimas semillas de sus sembrados, para presentarlas en las ferias y exposiciones celebradas en aquella provincia durante los años 1867 a 1880, que le valieron varios premios.

La producción del café aumentaba de año en año en Lipa hasta 1889, en cuya época las dos terceras partes de este pueblo se habían dedicado a su cultivo, llegando a pagarse entonces hasta 25 pesos por picul.

Verdad es que se laboró por dar impulso al café, y aparte de las disposiciones que desde 1780 se dictaron, vese que en 1831 el gobernador Enrile ofrece 7,000 duros al que exhibiera una hacienda de 40,000 pies de buena calidad en el segundo año de sembrado, y en 27 de julio de 1837 se asignan 1,000 pesos por presentar un cafetal de 60,000 plantas en estado de segunda cosecha a Mr. Pablo Gironier, un cirujano francés que había venido a Filipinas en 1820, y que luego fué autor de apreciables libros y se casó con una hija del país, donde residió veinte años. Luego se conceden dos premios de 1,000 y de 500 pesos en 22 de septiembre de 1846 a don Yñigo González Azaola, por haber cultivado dos plantaciones de café.

Un conocido escritor hispano, don Manuel Scheiduagel, siendo gobernador de Abra, sembró café en 1875 en las cercanías de Galiano, en Benguet, y en 1884 se descubrió que en Nueva Vizcaya se criaba espontáneamente el café, es decir, su cultivo se fué extendiendo y llegó a ser de los sembrados que mayores rendimientos proporcionó.

Por otra parte, no es de extrañar que nuestros compatriotas tomaran con ahinco la siembra del café, si se tiene en cuenta que el grano producido por las provincias de La Laguna y Tayabas, era tan apreciado como el de Java y el de la Martinica, no superándole el de Moca, al que se criaba en Silan y en Mindanao, así como el de Batangas y Camarines, que era el conocido con el nombre de Caracolillo, considerado como el mejor en su clase, y que dió a ganar un platal a los hacenderos hasta casi los últimos días de la dominación española, en que desgraciadamente, quedaron destruídas aquellas extensas plantaciones por haber sido atacadas por la enfermedad conocida con el nombre de Unus, que viene a ser el gorgojo que produce la larva de un coleóptero (escarabajo) de mediano tamaño, del grupo de los Longicornius, figurando también entre los enemigos del café la enfermedad conocida en el país con el nombre de Dapulak, producida por un pequeño hemíptero, conociéndose además en Batangas y Tayabas, otra especie denominada Bagombon, que es la larva de un lepidóptero nocturno (mariposa) y que también causa bastante daño.

Por lo general esos bichos se desarrollan en las ramas de la Madre cacao que se siembra para resguardar al café, y de aquél se trasladaban a éste.[1]

Lo cierto es que Lipa, sobre todo, por ser la comarca más antigua en el cultivo del café, y cuya riqueza obedecía a este producto, decayó bas-

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[1] Vide: Sánchez y Sánchez, Domingo. *Memoria sobre un insecto enemigo de los cafetos, Manila,* 1890.

tante, y lo mismo les ocurrió a los pueblos de San José y Rosario de la misma provincia, así como a los de Alaminos, San Pablo y Dolores, de La Laguna, y a los de Camarines, Kawit y Mindanao que vivían del café, de cuya producción y valor da idea la siguiente estadística:

Año	Kilogramos	Dollars
1854	852,571	145,344
1864	1,803,935	528,511
1874	2,854,270	990,574
1884	7,529,564	1,286,402
1894	603,156	177,518

Como se ve, fué lucrativo el café hasta 1890, y despertó de nuevo entusiasmos en los albores del siglo XX, como tendremos ocasión de expresar después, con motivo de la llegada de los americanos.

Del añil dice el duque de Almodovar, que es un precioso género que antes era de mala calidad, cultivado con descuido y casi inservible, pero desde el año 1779 se logró un método de beneficiarlo como en Guatemala.

Lo que sí se sabe es, que la primera siembra de añil se hizo en la hacienda de Tambobong, así como luego se realizó en el pueblo de Baliwag, en Bulacán, siendo ésta entonces una de las fuentes de riqueza de esa localidad, vendiéndose generalmente a 90 pesos (en esa época eran duros) el quintal, y aun rendía algún beneficio su exportación.

Por cierto que con motivo de las transacciones de este producto, hubo sus más y sus menos entre los agricultores y acaparadores, y un escritor de esa época, nos refiere que era muy común por entonces este cantar:

Kung ibig mong magkautang
Ikaw ay magtitinaan
Kung di ka makapagkintal
Ikaw ay makikintalan.

que traducido al castellano quiere decir:

Dedícate a hacer añil,
Si quieres te den prestado;
Si no entregas el quintal
Seguro saldrás mercado.

Toma el mando de las Islas el gobernador don José Gardoqui y Jarabeitia, que llegó a recorrer el Archipiélago con propósito de estudiarlo, y en 3 de diciembre de 1813 dictó unas instrucciones para el empadronamiento de cosecheros de tabaco en el partido de Gapang, método que habían de observar para conservar la semilla, formación de los almácigos a las tierras que hayan de cultivar, realización y conservación de las plantaciones, hasta hallarse el tabaco en sazón para beneficiarlo: para el gobierno de los caudillos de los barrios de la siembra de esa planta, mejor cultivo y beneficio de ella, y reglas para los aforadores de tabaco. Se encargaba que la semilla debía ser la de pampano, que produce hojas anchas, redondas y gruesas, que son las preferidas por buena calidad y gusto, desterrando las de las clases *Isinai* y *Minustasa,* formándose los almácigos desde 1.° de octubre; que la transplantación se hiciera a tiempo, no siendo de menos de dos pies la distancia de una palma a otra, para que pudiera producirse buen tabaco de todas las calidades desde 1.ª a 6.ª; que se despunten y capen las hojas, que no se tasmee hasta hallarse en sazón; que se cuelguen en los camarines de oreo, etc.[1]

[1] Como tendremos ocasión de nuevo de hablar del tabaco, entonces haremos su reseña.

Se había, pues, roto el hielo; de nuevo se hallaba sobre el tapete el importante problema agrícola, y no podía haberse olvidado por nuestros primeros representantes a Cortes en el Congreso español, una cuestión que afectaba de modo tan directo a nuestras fuentes de riqueza, por lo que nuestro primer diputado, el ilocano Sr. Ventura de los Reyes, presentó en 8 de octubre de 1813 ante la Cámara hispana, un proyecto cuya finalidad era el beneficio de la agricultura; es más, una vez suspendida la representación a Cortes de nuestro país, el Sr. González Azaola aprovechándose de la autorización que se concedió de presentar peticiones, fundado en la falta de brazos para atender a los extensos terrenos cultivables, solicitó que se permitiera la entrada de chinos en estas Islas para dedicarlos a la agricultura, y luego en 2 de diciembre de 1814 se dispone por real orden, el mayor y mejor fomento de la agricultura y de la ganadería, por medio de una justa libertad, dándose a conocer en 5 de marzo de 1817 un procedimiento para mejorar la calidad del azúcar.

Llegamos a una época (22 de diciembre de 1841) que registra el restablecimiento de la "Real Sociedad Económica de Filipinas" que en su iniciación en la época de Basco y Vargas, había tenido predilección, como hemos visto, por el desarrollo de nuestra riqueza, y necesariamente había de confiarse en que al volver de nuevo a cumplir con la misión que se le había impuesto, fijaría su vista en este ramo, como así aconteció, pues el gobernador Folgueras entusiasta por esta institución, y a la cual él mismo pertenecía, previno primeramente en 22 de junio de 1820 la redacción de una "Memoria" sobre el estado de la agricultura, y luego dispuso en 29 de enero del año siguiente, que se creara en Manila una junta cuya finalidad fuera la de promover ese ramo.

Sin duda ninguna había decidido propósito, se había comprendido el interés que despertaban nuestros campos, cuando en 10 de abril de 1822 una real orden recomendaba se dé cumplido efecto a otra de 1821 estableciendo cátedras de agricultura y un jardín de aclimatación, al par que también recomendaba el cultivo de la seda, algodón, añil, especerías, azúcar, canela y cacao, facilitando terrenos al efecto, ya del común o del Estado, y previene la forma en que las juntas creadas con ese motivo, habían de dar cuenta periódicamente del estado de la agricultura y de los medios para remover los obstáculos que se oponían a su desarrollo, y como confirmación de los buenos deseos en que entonces se inspiraban, tiénese una circular de 28 de noviembre de 1825, en que se cita el celo de los jefes provinciales, para que promuevan el cultivo en beneficio de los "preciosos frutos del país (palabras textuales)."

Y si no bastaran esos antecedentes para comprobar el interés de que hablamos, viene a comprobarlo más el acuerdo de la "Sociedad Económica" de 1.° de marzo de 1823 donando 250 duros anuales para ayudar a dotar a las Islas de una cátedra de agricultura, que desgraciadamente no llegó a establecerse por sin fin de dificultades que surgieron al tratar de realizar aquel empeño.

Dampier, un caballero inglés que allá en 1668 residió en Mindanao, había proporcionado los primeros informes del abacá, y al fin de la segunda decena del siglo XIX, se realizó la primera exportación de ese riquísimo textil a Massachusetts en los Estados Unidos de la América del Norte, por un total de 41 toneladas.

Sin duda la "Sociedad Económica" en su afán de estudiar nuestra agricultura, llegaría a tener conocimiento de esos informes, cuando en 6 de octubre de 1825, cooperando a las actividades que por esos tiempos

se venían desarrollando, presentó la primera "Memoria" sobre el cultivo del abacá, del cual en esa época, ya se habían exportado 276 toneladas, y doce años después, en 1.° de mayo de 1837, se recogían las primeras muestras en la provincia de La Laguna.

Como se trata de una fibra de gran valor, de ella se han ocupado varios escritores, pudiendo citarse, entre otras cosas, una exposición que en 10 de junio de 1875 se dirigió al Rey acompañada de una "Memoria" en la que entre otras cosas, se habla de la importancia del abacá; puede señalarse también otra "Memoria sobre el beneficio del abacá a máquina" que el Sr. Abelardo Cuesta presentó en 1887 a la "Sociedad Económica" y el trabajo de Jordana en 1888 titulado "El abacá," aparte de citarse esta planta monocotiledónea ya desde 1787 en la obra de Martín Sesse "Flora Mexicana," de igual manera que José Pavón habla de ella en 1797 en su "Flora peruana, chilena y filipina," y luego, en 1810 Alejandro Humbolt la menciona en su "Geografía de las plantas" y también hacen referencia a la misma otros muchos.

De tal importancia es para Filipinas el abacá, que su exportación ha ido creciendo, y así como en 1894 produjo 7,262,396 dollars, en 1903 se llegó a mandar fuera del país 126,500 toneladas que representaban un valor de 21,701,575 dollars, y así en esa forma continúa el acrecentamiento, dándose después de la primera decena de la presente centuria, la siguiente estadística de exportación:

Año	Cantidad en kilos	Valor en pesos
1910	163,173,211	32,950,622
1911	148,202,047	28,970,254
1912	175,137,180	44,151,344
1913	119,821,485	42,242,168
1914	116,386,575	38,389,630
1915	142,010,431	42,678,200
1916	137,326,092	53,384,593
1917	169,435,204	93,615,559

Complemento para el impulso de ese ramo, fué la real orden de 6 de abril de 1828 cumplimentada en 21 de octubre siguiente, sobre introducción de máquinas agrícolas en el Archipiélago, de tanta necesidad para el desarrollo, por el auxilio que presentarían a cuantos hacenderos veían en esos aparatos, no sólo una ayuda en sus operaciones de laboreo, sino al propio tiempo, el medio de economizar tiempo y hacer más eficaz el trabajo.

En esta última fecha, se establecen premios para los agricultores que se distingan en la preparación del añil y el cultivo de otros frutos; se concede un premio de 8,000 pesos a los dos primeros labradores que presenten un cafetal de 60,000 pies, así como otros premios de 6 y 4,000 pesos a los que logren exhibir cafetales de menor importancia. También se ofrecieron premios de 8 y 6,000 pesos a los que consiguieran poseer plantaciones de cacao, y otros de 15 y 12,000 pesos, por tener sembrados de canela, eximiendo del tributo a todo el que trabajara cinco años a jornal en cualquiera hacienda, a satisfacción de su propietario.

Hemos hecho referencia a la caña de azúcar, producto del cual se han ocupado porción de escritores con ánimo de acrecentar su desarrollo.

Y tenían razón los que pensaban en la propagación de la caña, cuyos rendimientos producían no pequeños beneficios al país, como había ocurrido en otras partes desde tiempos antiguos, pues era conocido este producto desde antes de la era cristiana, siendo originaria del Asia, desde

donde se trasladó a la Arabia, conociéndosela ya en el siglo IX en la antigua Persia, donde los árabes refinaban el azúcar, pasando a Venecia en 999 procedente de Alejandría, y, sólo se extendió su cultivo en el siglo XII al Norte del África y al mediodía de Europa, donde se establecieron los primeros trapiches.

En Filipinas cuando llegaron los españoles, había gran abundancia de cañas de azúcar [1] y hasta el gobernador Sande nos habla de ingenios de azúcar.[2]

La forma de pilón que se da al azúcar está tomada de China.

Por primera vez se exportó azúcar en 1835 por la cantidad de 11,777,000 kilogramos, viendo como crecía la salida del país de tan rico producto, hasta el extremo de que en 1894 fuera de 210,646,336 kilogramos con un valor de 5,474,422 dollars.

Al dar comienzo a la presente centuria, el azúcar exportado ha tomado grandes vuelos, como lo demuestra la siguiente estadística:

Año	Kilos	Valor en pesos
1900	90,869,008	26,580,800
1901	126,245,112	31,953,280
1902	113,284,000	38,581,220
1903	139,956,032	44,001,176
1904	123,588,192	41,888,354
1905	130,437,128	43,514,688
1906	104,078,024	39,225,264
1907	117,241,320	39,378,986
1908	131,882,008	33,003,912
1909	167,953,119	33,792,000
1910	163,173,211	32,950,622
1911	148,202,047	28,970,254
1912	175,137,180	44,242,168
1913	119,821,435	42,242,168
1914	116,386,575	38,889,630
1915	142,010,431	42,678,200
1916	137,326,092	58,384,592
1917	169,435,204	93,615,559

¿Cómo se introdujo el cacao en Filipinas? Un religioso agustino, Fr. Casimiro Díaz,[3] hablando del cacao dice: "La causa de la abundancia es el haber traído el año de 1670 un piloto, llamado Pedro Bravo, de Lagunas, una maceta de un pie de cacao de Acapulco. Dióosele a un hermano suyo Clérigo Beneficiado de Camarines, llamado el bachiller Bartolomé Bravo. A éste se le hurtó un indio natural de Lipa llamado D. Juan del Águila, el cual lo escondió y benefició, y de este pie de cacao tuvo su origen lo mucho que abunda en estas Islas este fruto tan noble."

Otro religioso, el recoletano Fr. Juan de la Concepción,[4] refiriéndose al fallecimiento del sacerdote jesuita P. Juan Dávila, se expresa así: "Empeñó el Sr. Gobernador D. Diego Salcedo, que mandase traer de Nueva España algunos pies de cacao para plantarlos en Visayas. Consiguióle el Padre, estando en Carigara (Leyte), en donde se empezó a plantar a su dirección con buen suceso; de allí se propagó a otros pueblos e Islas de Pintados,

[1] En el memorial del P. Alonso Sánchez de 1578, se dice entre otras cosas: "* * * Tiene (se refiere a estas Islas) grande abundancia de miel y cañas de azúcar * * *"

[2] Así lo leemos en una carta del Dr. Sande de fecha 8 de junio de 1577, donde habla de diversas cosas, y que figura en el estante 1 caja 1 del legajo 2.24 del Archivo de Indias de Sevilla.

[3] Vide p. 43 de "Conquistas de las Islas Filipinas. Valladolid, 1860."

[4] Vide Vol. IX, pp. —— y 151 de "Historia General de Filipinas, Sampaloc, 1790."

con provecho grande de los Indios y pública utilidad de las Islas" y a su vez el P. Blanco en su grandiosa *Flora de Filipinas* (Vol. II, p. 407), haciendo mención del gobernador Salcedo, dice: "Habiendo tomado posesión de su gobierno en 1663, es muy probable, que con la remesa de cacaos que vino de orden suya de América, trajesen los particulares algunos otros: y así al mismo tiempo que se extendía el cacao por Carigara, donde se hallaba el P. Dávila, y por otras partes, se propagase también por tagalos. El año de 1674 siendo párroco de Lipa el P. Ignacio Mercado, dice que repartió semillas de este árbol a muchas personas."

Buzeta y Bravo[1] dicen refiriéndose al cacao, que se siembra desde el mes de noviembre, hasta el de enero, en una tierra colorada, un poco arcillosa, que se ha reconocido ser la más a propósito: pero antes se dejan humedecer bien los granos de su cápsula, teniéndolos algunas horas en agua: se plantan a distancia de tres metros, un pie de otro, y a la sombra de los bananos, en cuanto sea posible. Leyte, la Isla de Negros, Cebú, Bohol, Sámar, Misamis, Caraga, La Laguna y Pangasinán son las provincias que producen el cacao, en más o menos abundancia; pero las que lo dan en mayor cantidad son la Isla de Negros y las provincias de Cebú y de Sámar. El que se cría en Cebú es de una calidad tan superior, como el de Caracas; el de la Isla de Negros crece espontáneamente en las montañas habitadas por los igorrotes y los negritos y rivalizan con el de Ternate y Manado.

Sin embargo, desde el año 1850 en que se escribió lo que se transcribe, hasta la fecha, las cosas han cambiado un tanto, y hoy en Filipinas se cría una buena cantidad de cacao, como que en 1903, se daba en todas las provincias, menos en Benguet, Lepanto Bontok y Siasi, siendo su área de cultivo de 3,521 hectáreas en todo el país.

El canelo debe ser antiquísimo. La sagrada escritura ya lo cita, y a juzgar por todos los indicios, su cuna parece ser Ceylán, desde cuyo punto se extendió a Malabar, Sumatra, Conchinchina, Tonkin, China, Borneo, Timor, Nicobor y Joló siendo introducido en nuestro Archipiélago por la Compañía de Filipinas.

Mientras por un lado el status político del país, se puede decir que permaneció en *statu quo*, en cambio la agricultura tuvo de su parte autoridades y particulares que por ella velaron en el siglo XIX, como había acontecido en el anterior.

Cuando el marqués de la Solana, General don Antonio de Urbiztondo,[2] se hizo cargo del gobernalle de las Islas, siguiendo el ejemplo de sus antecesores, se dedicó a estudiar las cuestiones agrícolas, y dictó en 5 de agosto de 1850 una disposición dividiendo a los hacenderos en dos clases, al par que como medida de impulso a la labor agraria, autorizó el establecimiento de colonias de chinos.

En esa fecha en que ya había quien se dedicaba a la investigación de las plantas, se halló en los alrededores de Manila el té silvestre y la quina, y poco después, como prueba del interés que venía despertando ese estudio, el agustiniano P. Antonio Llanos, da a luz con fecha 1851, en Manila, su apreciable trabajo *Fragmentos de Algunas Plantas de Filipinas no incluidas en la Flora de las Islas, de la 1.ª ni 2.ª edición* (se refiere al libro del P. Blanco.)

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[1] "Diccionario Geográfico Estadístico Histórico de las Islas Filipinas. Madrid, 1850." Vol. I, p. 29.

[2] Este gobernador se posesionó del cargo el 29 de junio de 1850 y cesó en dicho puesto el 20 de diciembre de 1853.

La autorización de colonias de chinos para la agricultura quedó más reforzada, al disponerse en 28 de julio de 1851 que se concedía un año de exención de tributo, al chino que por primera vez llegara a las Islas, con lo cual se facilitaba grandemente la inmigración de los de esta raza.

Se han promovido con bastante frecuencia grandes escisiones entre el capital y el trabajo por diferencias en las cuestiones económicas, dándose a veces casos de sostenerse una verdadera alteración de orden público, y el gobierno llamado a evitar contiendas de esa naturaleza, dispuso en 1.° de marzo de 1855 que los jefes de provincias podían hacer adelantos a los cosecheros de tabaco, a razón de 100 pesos por cada quiñón de tierra de cultivo.

Ese mismo entusiasmo; las actividades y energías desarrolladas entonces; el impulso dado a determinados frutos; el trabajo a placer que se impusieron nuestros cosecheros, fueron causa de que hubiera verdadera abundancia de nuestros productos, y, para procurar mayor beneficio, en 25 de agosto de 1855, se autorizó la libre exportación del comercio de arroz,[1] siempre que su precio en Manila no excediera de 18 reales, o sean 2.25 pesos (entonces circulaba el oro), y 14 reales en provincias (₱1.75).

En esta época al intervenir el Gobierno, dictó la real orden de 29 de abril de 1856, que decía:

Excmo. Sr.: Enterada la Reina (Q. D. G.) de la carta de V. E. señalada con el número 195, fecha 7 de septiembre del año último, así como de los ilustrados informes que la acompañan, y fija constantemente su atención en facilitar la producción agrícola que no reconoce otra base que el consumo, ni más poderoso vehículo que la libertad de las transacciones mercantiles, ha venido en reconocer que si bien el bando de V. E. publicado en 29 de agosto próximo pasado es un verdadero adelanto respecto a las disposiciones tomadas anteriormente en épocas de carestía, debía en lo sucesivo evitarse con cuidado el error de suponer que la prohibición de la exportación y demás medidas oficiales encaminadas a abaratar especies dadas, tengan para llegar a este fin el probado poder de la libertad del tráfico, mediante el que nunca puede hacerse esperar mucho la deseada nivelación entre los precios corrientes de los distintos mercados y entre el de las diversas especies cambiables según las leyes relativas de la producción y del consumo. En el caso a que se concreta la carta de V. E., la Reina (Q. D. G.), estimando que nada contribuirá tanto al fomento de la agricultura en esas Islas y al enriquecimiento de sus habitantes como la frecuentación del mercado chino en que la necesidad del arroz de Filipinas multiplicará el comercio entre ambos países, siempre que no se interrumpa la inspirada acción del interés particular, ha tenido a bien disponer lo siguiente: 1.° El comercio del arroz y del palay entre los puertos y provincias de las Islas Filipinas se hará en lo sucesivo con entera libertad y sin sujeción a otras reglas o formalidades que las establecidas por la Superintendencia para el embarque o alijo de los demás efectos de libre tráfico. 2.° La exportación del arroz y del palay para el extranjero se verificará precisamente por los puertos siguientes: El de Manila en la provincia de Tondo; Sual en la de Pangasinán; Currimao en la Isla de Ilocos Norte; Salomague en la de Ilocos Sur; San Miguel en la de Camarines; y por los de Zamboanga, Iloílo, Cápiz y Antique en las provincias de su

[1] Ya en 1824 la Sociedad Económica había gestionado el libre comercio del arroz, y solicitó de los Estados Unidos máquinas para descascarar el palay, y en 17 de julio de 1836 se declaró libre el comercio de arroz así como su exportación.

mismo nombre, como también por todos los demás en que existiera aduana habilitada para el comercio extranjero. 3.° Para la exportación del arroz y del palay no se requiere licencia especial del Gobierno ni más formalidades que las prescritas por regla general a los artículos de libre tráfico.

¿Qué ocurrió con el arroz en años posteriores? Indudablemente las cosechas disminuyeron, pues al tomar posesión del mando de las Islas el gobernador don Fernando de Norzagaray y Escudero el 6 de marzo de 1857, uno de los más vitales problemas que se presentó a su consideración, fué el precio fabuloso que había alcanzado el arroz por la escasez de la cosecha y la carestía de este cereal en China, y en la imperiosa necesidad de velar porque no se tropezara con dificultades, tratándose de un alimento de primera necesidad para los filipinos, un decreto de 18 de junio de 1857 autoriza la introducción del arroz y palay extranjero hasta el 31 de enero del año siguiente, plazo que luego en 30 de noviembre del mismo año 57 no sólo se amplía indefinitivamente, sino que de nuevo autoriza su entrada libre de derechos.[1] Sin embargo, se sabe que en 1868 se exportaron de Pangasinán grandes cantidades de arroz para China, y de Manila salió asimismo una respetable cantidad para otras colonias del extremo oriente.

Allá en 1875 al celebrarse la Exposición de Filadelfia, por primera vez en un concierto mundial de esa naturaleza, revela Filipinas su riqueza, presentándose por nuestro compatriota ya fallecido, el Sr. Regino García, una colección de 120 variedades de arroz que llamaron poderosamente la atención de cuantos acudieron a aquel certamen.

Incuestionablemente el azúcar, abacá, tabaco y otros productos, debieron haber hecho comprender que proporcionaban mayores beneficios que el arroz, y la cosecha de éste disminuyó notablemente hasta el extremo de que llamara la atención.

La cuestión económica, era sin duda, de las que más interesaban, y sucedió lo que tenía que suceder que el Gobierno no podría permanecer con los brazos cruzados, y así como en tiempo del general Norzagaray se presentó como problema serio esta cuestión, volvió a ponerse sobre el tapete de nuevo[2] y así vemos que en 1879 se decía:[3] "Siendo el arroz el alimento general de estos habitantes y antes muy frecuentes los años de escasez, es natural hubiese dado lugar a multitud de medidas gubernativas con tendencia todas a abaratarlo y a asegurar suficiente provisión al país. Todo lo que conoce la Europa como legislación antigua y moderna de subsistencias, se ha ensayado aquí. La prohibición de exportar, la escala de precios limitadores, la tasa, los pósitos, y con las correspondientes reclamaciones contra los traficantes en grano llamándoles logreros, acaparadores, etc. etc.; hasta en un bando del siglo pasado se prohibió la reventa, advirtiendo a las mujeres que se dedicaban a ella, que era mejor "empleasen el tiempo en hacer calceta;" en fin, el empirismo y el proteccionismo ten-

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[1] Admira ver como pudo haber en esa época falta de arroz, cuando había provincias, como la Pampanga, donde se daban cuatro cosechas. El P. Martínez Zuñiga (Vol. I, p. 463) dice: "* * * En la Pampanga se hacen cuatro cosechas de arroz, porque se hacen en distintos tiempos, y cada una tiene su particular cultivo * * *"

[2] Pueden verse los siguientes trabajos:

La admisión temporal de los arroceros de la India (Revista Filipina de Ciencias y Artes, p. III).

Elías de Molins, José: La importación temporal de los arroceros de la India y Filipinas. Manila, 1883.

[3] Vide Diccionario de la Administración, del comercio y de la vida práctica en Filipinas, por don José Felipe del Pan, con la colaboración de don José de la Rosa. Tomo I, Manila, Imprenta de don Manuel Pérez, 1879, p. 111.

drían mucho que admirar en la colección legislativa local relativa al tráfico de cereales, encontrando por conclusión que las antiguas hambres y las modernas carestías (fué la última en 1856 y 1857) no desaparecieron del país hasta que el Estado dijo: "Cualesquiera que sean las circunstancias y las procedencias, el comercio del arroz es enteramente libre en Filipinas, así para el tráfico interior como para el exterior."

"La producción de arroz ha disminuido notablemente en el país, por faltarle el aliciente del mercado chino, provisto con más abundancia y baratura de arroz cochinchino desde que los franceses se establecieron en Saigón. Hoy no se exportan cereales, y cuando el precio del arroz más ordinario llega a 14 reales, viene arroz de fuera a contener mayor subida. Han sido dedicados al azúcar y otros cultivos los terrenos que daban el sobrante de producción en años de buena cosecha; siendo patente el beneficio que de ello resulta a los habitantes. Son considerados como los más atrasados y pobres los pueblos exclusivamente cosecheros de arroz.

"Es difícil determinar la producción exacta del arroz en estas Islas, decía en 1911 un escritor,[1] pudiendo hacerse solamente un cálculo aproximado tomando por base el área de cultivo y el probable consumo por cabeza. Informes de carácter semi-oficial, hacen subir el área de cultivo del arroz en 2,732,572 acres. Una pequeña parte de esta área cuenta con irrigación y en ella se recogen dos cosechas, y en ocasiones hasta tres, al año. Pero la gran porción de los terrenos arrozales depende de las lluvias cuyo retardo o disminución ponen en grave peligro la cosecha. Entre los terrenos clasificados como destinados al cultivo del arroz, está incluida una porción considerable de tierras que se destinan al cultivo del arroz de un modo intermitente, es decir, que se plantan de arroz un año si y otro, o más años no.

"El rendimiento ordinario se estima de veinte a cincuenta cavanes por hectárea. Un caván tiene unas 120 libras y una hectárea unos dos y medio acres. Así, la producción rendía entre 960 y 2,400 libras por acre. Suponiendo que se recoja media tonelada de arroz por término medio en toda el área clasificada como destinada al cultivo del arroz, la producción total sería de 1,366,286 toneladas. Por otra parte, si suponemos que el consumo diario por cabeza es de tres cuartos de una libra, el total para ocho millones de individuos sería de seis millones de libras diarias o 993,165 toneladas al año.

"La importación durante el año pasado alcanzó a 184,019 toneladas indicando una producción local de 808,546 toneladas que es medio millón de toneladas menos que el cálculo de producción basada en el rendimiento por acre. El importe del arroz importado es de unos ochenta pesos, y se elevaría, calculando el consumo por cabeza, a unos sesenta y cuatro millones de pesos.

"Antes del siglo diez y ocho, el arroz figuraba en la lista de exportaciones. Producíamos entonces más de lo necesario para el consumo interior. Con el desarrollo del azúcar, del abacá y de la copra el arroz sufrió una gran merma en la producción. Aquellos productos atraían mejor los esfuerzos de los hombres trabajadores por el mayor beneficio que daban. Desde la ocupación americana, esta merma en la producción de arroz parece estar en aumento. El hecho es que la importación de arroz ha sido en

[1] Véase p. 773 de *El Renacimiento Filipino* de 14 de diciembre de 1911.

los doce últimos años mayor que en cualquier otro período de la historia de Filipinas.

"Aunque el arroz es todavía la mayor producción de estas Islas al presente, no figura de un modo prominente en el comercio del Archipiélago como los otros productos, por la razón de que la mayor parte, si no toda la cosecha, es consumida por los mismos que la producen.

"Durante los últimos quince años se ha registrado una gran demanda de arroz en los pueblos que se alimentan de este cereal cuyo precio se ha elevado considerablemente."

Según los informes del administrador de Aduana, desde 1899 a 1917 las importaciones de arroz son como sigue:

Año fiscal	Toneladas	Valor
1899	58,389	$1,939,122
1900	109,910	3,113,423
1901	178,231	5,490,958
1902	216,403	6,578,481
1903	307,190	10,061,293
1904	329,925	11,548,814
1905	255,502	7,456,788
1906	138,051	4,375,500
1907	112,748	3,662,193
1908	162,174	5,861,256
1909	187,677	4,250,223
1910	184,619	5,321,962
1911	183,675	13,544,494
1912	301,057	26,017,012
1913	86,990	6,329,182
1914	96,921	6,552,296
1915	218,442	13,448,551
1916	189,836	13,043,642
1917	146,986	10,781,463

No podía ni debía olvidarse tratándose de un país como Filipinas, lo que significaba el valor de la agricultura, y así como la Sociedad Económica demostró interés grandísimo por este ramo al redactar en 1781 sus primeros estatutos, y, en repetidas ocasiones, concedió premios para fomentar esa fuente de riqueza, igual se hizo años después.

Continuando con aquel pensar, promuévese por el superior gobierno de estas Islas un expediente como consecuencia de la real orden de 26 de febrero de 1821, con el propósito de establecer en Manila una cátedra de agricultura, y siguiendo la Sociedad Económica en su afán de favorecer todo lo que propendiera al levantamiento de nuestra riqueza agraria, ofrece a la autoridad costear el haber de un profesor dotado con 250 pesos anuales, pero desgraciadamente la escuela no se estableció.

Sin embargo, el interés que representaba este ramo para el desarrollo de un país de tan fértil suelo, forzosamente tenía que dar lugar a que fijaran su atención en la enseñanza agrícola aquéllos que de buena fe perseguían el adelanto de las Islas.

Propúsose la realización de tan interesante servicio, si bien nada se hizo de momento y quedó traspapelada esta propuesta, cuya finalidad laudatoria hubiera permanecido acaso más tiempo, sin darse a luz, a no haberse dispuesto por real orden de 29 de mayo de 1861, recomendándose por el gobernador Echague en la sesión celebrada por la Sociedad Económica en 17 de junio de 1863, la organización de la mencionada escuela.

La Sociedad Económica en su atinado informe de 13 de abril de 1869, después de estudiar los preceptos contenidos en los reales decretos de 2 de noviembre de 1849 y de 6 de febrero de 1867 vigentes en España para la organización de la enseñanza agrícola, estimó que el modelo más bello que imitar, era el del filántropo Fellenberg, que coloca tales establecimientos de manera que lleguen, no sólo a ser plantel de buenos cultivadores de la tierra, sino también un medio de educación pública, propio para formar el carácter de los alumnos, para infundirles la más pura moralidad, para transmitirles habilidad de disciplina y orden, y para habituarlos al más atinado uso de las facultades y ventajas propias de la aptitud y posición de cada uno, enseñando a los ricos la más acertada dirección de sus propiedades, y ofreciendo a los pobres un medio seguro y honroso de suavizar los rigores de su suerte.

La Sociedad Económica a la vez ofreció poner de su parte un terreno de cabida de 200 o más quiñones, adquiriéndolo con sus fondos, y solicitó un anticipo a reintegrar de 120,000 escudos para fundar la escuela de agricultura en una granja de reforma.

Mientras se trataba de poner en práctica la idea de establecer aquella escuela y los trámites alargaban la hora en que debiera darse poderoso impulso a esa instrucción, el Ayuntamiento que se preparaba a celebrar en junio de 1858 el natalicio del príncipe de Asturias D. Alfonso, después rey de España, y padre del que hoy rige el trono de San Fernando, hubo de fijarse en unos extensos terrenos que había en el campo de Arroceros, y procedió a ello sin pérdida de momento, con el poderoso apoyo del gobernador Norzagaray que tanto trabajó por el país, y obteniendo en recompensa de sus buenos propósitos, el decreto de 13 de septiembre de 1858, en el cual se disponía que el terreno de Arroceros se destinara a trabajos prácticos de una escuela de botánica y ensayos de sistemas de cultivo y beneficio de plantas.[1]

Así fué como de hecho comenzó la enseñanza agrícola, al par que se hermoseaba aquel sitio, que hoy constituye un espléndido lugar de expansión.

Siguiendo nuestra relación acerca del establecimiento de una escuela de botánica, podemos añadir que fué aprobada la determinación de la autoridad de estas Islas por el real decreto de 29 de mayo de 1861, que puso la escuela a las órdenes del gobernador superior y bajo la inspección de la Sociedad de Amigos del País, al par que aprobaba el presupuesto de gastos, y disponía a la vez, que los gastos del Jardín se sufragaran: 3,003 por el Tesoro Público; 1,500 por las Cajas de Comunidad, y otros 1,500 por los Propios y Arbitrios del Ayuntamiento, debiendo en cambio, ingresar a prorrata en su respectivas cajas lo que recaudaba por el Jardín.

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[1] Decía aquel precepto de la autoridad insular que se proponía aclimatar en el país plantas no explotadas, sirviendo así de enseñanza y de estudio.

La plantilla del personal y material de esa escuela, estaba constituída en esta forma:

	Pesos
Un profesor botánico	1,500
Dos maestros horticultores, a 500 pesos cada uno	1,000
Diez obreros alumnos escogidos entre jóvenes agricultores, que se sustituyeran por períodos de tres años y con el haber de 100 pesos cada uno	1,000
Adquisición de plantas y herramientas	1,500

Este gasto se cubría: pfs. 1,000 con fondos del Ayuntamiento; otros 1,000 de los del Consulado; 500 de la Sociedad Económica y 3,000 de las Cajas de Comunidad.

Encomendaba el decreto la cátedra de botánica a agricultura al director del Jardín, habiendo sido designado D. Francisco Ramos y Borguella como primer jefe de dicho establecimiento.

Sucedió al Sr. Ramos en este puesto D. Zoilo Espejo y Culebra,[1] quien a diferencia de su antecesor que, si bien trabajó bastante, lo hacía sin plan científico, demostró capacidad en el desempeño de su cometido, ordenando las plantas por familias y publicando una cartilla [2] y un catálogo.[3]

Trasladado el Sr. Espejo a la escuela central de agricultura en Madrid, con el cargo de profesor de Zootecnia, dispuso la real orden de 17 de mayo de 1876 que su puesto de director fuera desempeñado por el Inspector de Montes, economizándose así el haber de 3,000 pesos que se había consignado para el Sr. Espejo. Con esta reforma, principio de otras más que se dictaron en 17 de octubre de 1887, 1.° de mayo y 12 de agosto de 1878, experimentó cambios el Jardín Botánico, que ése es el nombre con que se conoce aquel sitio, aminorándose su presupuesto de gastos en forma tal que en 1892 satisfacía 2,600 pesos por gastos del personal y 1,000 más para el material. Los impulsos que recibiera del Sr. Sainz de Baranda,[4] y sobre todo de D. Sebastián Vidal,[5] dieron lugar a que se enriquecieran las especies herbáceas, exóticas y varias más.

Sufrió de nuevo reformas el Jardín Botánico, al advenimiento del régimen americano, quedando abierto al público.

Hemos hablado de las distintas especies que se encontraban en el Jardín Botánico, y debemos en obsequio a la labor allí realizada, consignar aquí, que fueron muchos los naturalistas extranjeros que al visitar aquel Jardín, expresaron su satisfacción por el estado en que lo encontraban, llamando la atención, la diversidad de rosas que allí cultivaban; el *bagabay* cuyas hojas resultan de eficacia para curarse los dolores reumáticos; la enredadera *lunas-lunas*, que aparte de poseer otras virtudes, tiene la de ser un activo contraveneno; el *eucaliptus*, el *miray* que produce el lienzo fino, y otras sin fin más de plantas, todas de inmediata aplicación en la farmacopea.

Siendo el tabaco uno de los veneros de riqueza más valiosos de Filipinas, cuyas excelentes condiciones motivaron el crédito tan grande que ha alcanzado, vamos a decir cuánto ha venido sucediendo desde los tiempos idos con esta planta solanácea.

Refiriéndose a la primera vez que los europeos conocieron esta planta, leemos:

"Parece que el tabaco fué descubierto en la parte oriental de la Isla de Cuba, en las márgenes del río Caunao, por varios de los hombres que

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[1] De esta escuela habla *El Faro Administrativo* y: "Origen e Historia del Botánico y de la Escuela de Agricultura, por D. Rafael García López, Alcalde mayor que fué de varias provincias en aquellas Islas. Madrid, Imprenta a cargo de Juan Iniesta, Hortaleza 128. Bajo 1870."

[2] "Cartilla de Agricultura Filipina, Segunda edición, Manila, Imprenta Ramírez y Giraudier 1870."

[3] "Catalogus Seminum Horti Botanici Manilensis Anno 1876 (Al final) Manila Apud Balthasarum Giraudier, MCCCLXIX."

Se han hecho otras ediciones, y las últimas van suscritas por los Sres. Salvador Cerón, Rufino García y Pío García.

[4] El Sr. Baranda, que era filipino, fué un ilustrado y excelente Ingeniero Jefe del ramo de Montes, que escribió una muy interesante *Memoria Sobre los Montes de Filipinas.*

[5] Ostenta hoy el Jardín Botánico una estatua que honra la memoria de aquel sabio ciudadano, a cuya ilustración se deben muchas y meritísimas obras científicas, que le dieron renombre aquí y en el extranjero. Falleció en Manila en 1890.

acompañaban a Colón, y entre los cuales se hallaban Rodrigo de Jerez, vecino de Ayamonte, y Luís Torres, judío bautizado, quienes después de posesionarse de la isla, se internaron algunas leguas en busca de oro. Estos aventureros fueron los que vieron por primera vez, en 12 de octubre de 1492, hacer uso de esta planta a los habitantes del país, los cuales la denominaban *cohiva*, *cogiva*, o *coviva*, pero a la que los descubridores dieron el nombre de tabaco, dícese que por confusión del nombre de la planta con el que los indígenas daban al instrumento, especie de pipa, en que absorbían su humo, pues en aquel tiempo la planta no servía para fumar, sino que se quemaba sobre carbones encendidos, aspirando su humo por medio de unos tubos largos, y expulsándolo después por la boca y las fosas nasales. También se ha dicho que se dió el nombre de tabaco por haberla visto por primera vez en Tabaco. El uso del tabaco era también muy general entre los indígenas de la Isla Guanuhani cuando Cristobal Colón desembarcó en ella. Gonzalo de Balden, que escribió en 1513, es el que ha consignado largos detalles acerca del uso de esta planta. En la América del Norte la costumbre de fumar con esta especie de boquillas o pipas, se confunde con el origen de los pueblos de esta parte del mundo, como lo prueba la frecuencia con que los instrumentos destinados a este uso, se encuentran en las tumbas desde la época más antigua."

Sin embargo de las manifestaciones consignadas en la transcripción anterior, un señor Doctor Morales, en apreciable trabajo que publicó en Sevilla en 1574, atribuye el descubrimiento del tabaco al religioso español Pane, asegurando que este viajó con Colón y fué quien envió la semilla de esa planta a Carlos V.

Juan Nicot la importó a su vez a Francia, y a eso se debe el nombre de *Nicotiana tabacum* con que en botánica es conocida esta planta. Con todo, discútese ese extremo, expresando que el religioso francés Andrés Thevet, fué quien primeramente la importó en 1556. En esa misma época, el obispo Nicolás Tornabona, que a la sazón se hallaba en Francia, envió semilla de tabaco a Toscana, propagándose así con el tiempo, por toda Italia.

Asegúrase que Sir Walter Raleigh que se dirigió a Virginia en 1583, encontró a los naturales fumando tabaco, y diez años después, enviaba semillas de esa planta a Irlanda, desde donde se propagó a Escocia y otros puntos de Inglaterra. Hay, en cambio, quien expresa que el almirante inglés Drake, fué quien la llevó de Tabaco a Inglaterra en 1585.

No transcurrieron muchos años sin que Filipinas tuviera a su vez conocimiento del tabaco.

Cuando el adelantado Hernando de Magallanes arribó a la Isla de Limasawa, de la provincia de Leyte, el 28 de marzo de 1521, los habitantes de este lugar al verlos como fumaban el tabaco, manifestaron que los españoles echaban fuego por la boca y por las narices.

Como tanto la expedición del primer adelantado hispano y las otras tres que le sucedieron, no obtuvieron éxito, a eso, indudablemente, se puede atribuir el no haberse propagado entonces el tabaco, pero al posesionarse Miguel López de Legazpi de Filipinas, que llegó a Tandayak, Sámar, el 13 de febrero de 1565, de nuevo reaparece el tabaco, que usaban los de la expedición del primer gobernante hispano en estas Islas, viéndose que ya en 1592 había tomado carta de naturaleza el tabaco en Filipinas, por la gran propaganda que de él se hizo.

Los españoles llevaron luego el tabaco al Japón, donde los hijos del país de los crisantemos, lo bautizaron con el nombre de tanpako.

En 1588 disputaban Si-Tik-Hong, Yad-Su y otros sobre la procedencia del tabaco en China, y mientras unos decían que los españoles lo introdujeron por el Japón, otros opinaban que fué por Emuy. Lo cierto es, que ya en 1641, el emperador tártaro se quejaba de que los chinos dejaban de tirar a la flecha, prefiriendo fumar el tabaco.

Desde luego el furor producido en el mundo por la propaganda de esta planta, halló oposición de parte de la Iglesia y de algunas eminentes personalidades, dándose el caso de que se lanzara la excomunión a los que hacían uso de esta hoja.

Víctor Mennier, uno de los más significados opositores, decía: "Los déspotas debían levantar estatuas a Juan Nicot, que les ha proporcionado el más poderoso narcótico de la energía humana;" mientras Stendhal, a su vez, expresó: "Si la Turquía lleva la noche en su rostro; si la Alemania sueña en el espacio; si España duerme con sueño entrecortado por el sonambulismo; si la Francia deja flotar su mirada insegura, debe atribuirse el misterio del suicidio nacional, al cigarro, al cigarrillo y a la pipa; por poco que la cosa dure, la inteligencia humana terminará en humo, y el mono podrá tratar con el hombre de igual a igual."

Voltaire, Rousseau y Mirabeau, personalidades de gran realce mundial entonces, también anatematizaron el tabaco, y Montesquieu en su afán de poner cortapisas al uso de esta planta, solicitó la redacción de una ley que evitara el uso del tabaco a los obreros, por medio de una tarifa que estableciera precios subidos para los cigarros, cigarrillos, picadura y la hoja.

Pedro el Grande, de Rusia, que aceptó el tabaco en sus dominios y que fué acerbamente criticado por el clero, para responder a los ataques a él dirigidos, expresaba: "El tabaco debe ser el mayor de los recursos con que cuenten los reyes en los tiempos futuros; pero en Rusia carecerá de importancia por la dificultad, ahora insuperable, de vencer obstáculos con que lucho para extender su consumo. El Patriarca ortodoxo, en odio a los turcos que usan con pasión esta yerba, persigue encarnizadamente a los fumadores rusos, contra los que han lanzado la excomunión; en esta situación, no pudiendo contrarrestar la influencia del clero, después de pensarlo mucho, entiendo haber encontrado la manera de hacerla ineficaz para llegar al resultado que me propongo. No me interesa la utilidad insignificante y mezquina de esos cien mil escudos; otra busco y con otra cuento: los especuladores nunca han reparado en los medios de realizar ganancias, razón que me hace confiar en el ingenio de esos mercaderes de Londres; los cuales, de seguro, se darán buena traza y lo harán de forma que el tabaco espero se hallará en breve plazo dentro de las casas de todos los rusos, sin exceptuar las de los sacerdotes, pese al Patriarca y al clero intransigente, como han llevado el opio a otros dominios; y entonces, sin violencia ni contrariedad, habré conseguido mi objeto, y lo que produce poco, luego será tesoro inagotable."

Cuando a Filipinas vino en el mes de julio de 1778 para gobernador general don José Basco y Vargas, joven activo e ilustrado, algo conocería de cuanto se había hablado del tabaco en otros países, cuando como si se hubiera inspirado en el criterio sustentado por Pedro el Grande, vió en el tabaco un medio poderoso de ingreso para el tesoro.

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AGRICULTURAL CONDITIONS IN THE PHILIPPINES, 1921

By Antonio Peña

Chief, Division of Farm Statistics, Bureau of Agriculture

Nineteen hundred and twenty-one, though the most prosperous year for sugar cane, rice, and coconuts, was a year of general dissatisfaction for our farmers, on account of the sudden fall of prices in the latter part of 1920. The frantic post-war race for fortune featured the world over by speculation and extravagance, left a heavy crop of the disillusioned here in the Philippine Islands to bemoan vanished profits, capital sunk in high priced but unsalable merchandise, a high rate of exchange, general unemployment, curtailed credit and glutted markets.

It was under such critical conditions that our farmers sent their 1921 crops to the markets. Possibly, the loss that growers sustained would not have been very heavy had the products been raised later. Unfortunately, their crops were grown and matured or gathered at the high rate of wages prevailing before the actual crisis, while the prices had in less than one year suddenly fallen to what they had been four years back.

Except for periods of heavy rains and typhoons which caused floods in some localities, the weather in the Island of Luzon during the year reviewed was as a whole dry and somehow hot, while the Visayan and Mindanao Islands had a rather rainy year.

Five typhoons crossed the Archipelago. Two, one in July and another in August, 1920, passed through the Balintang Channel, the first one causing heavy rains which further damaged the wilting crops of rice and corn in northern Luzon; and two typhoons, both in August, went over the same island, one through the central regions causing losses in the sugar and rice crops of the valley, but benefiting those in the plateaus. The fifth typhoon, which occurred early in November, struck Mindoro, after passing over the Islands of Samar and Romblon, and further injured the corn crops of the provinces in or near its path.

The terrible fall of tobacco prices which began some time before the planting season, produced much unneasiness among the planters, as a result of which many of them decreased their ordinary hectarage, while the abaca and maguey growers for the same reason turned some unproductive plantations to the cultivation of food crops.

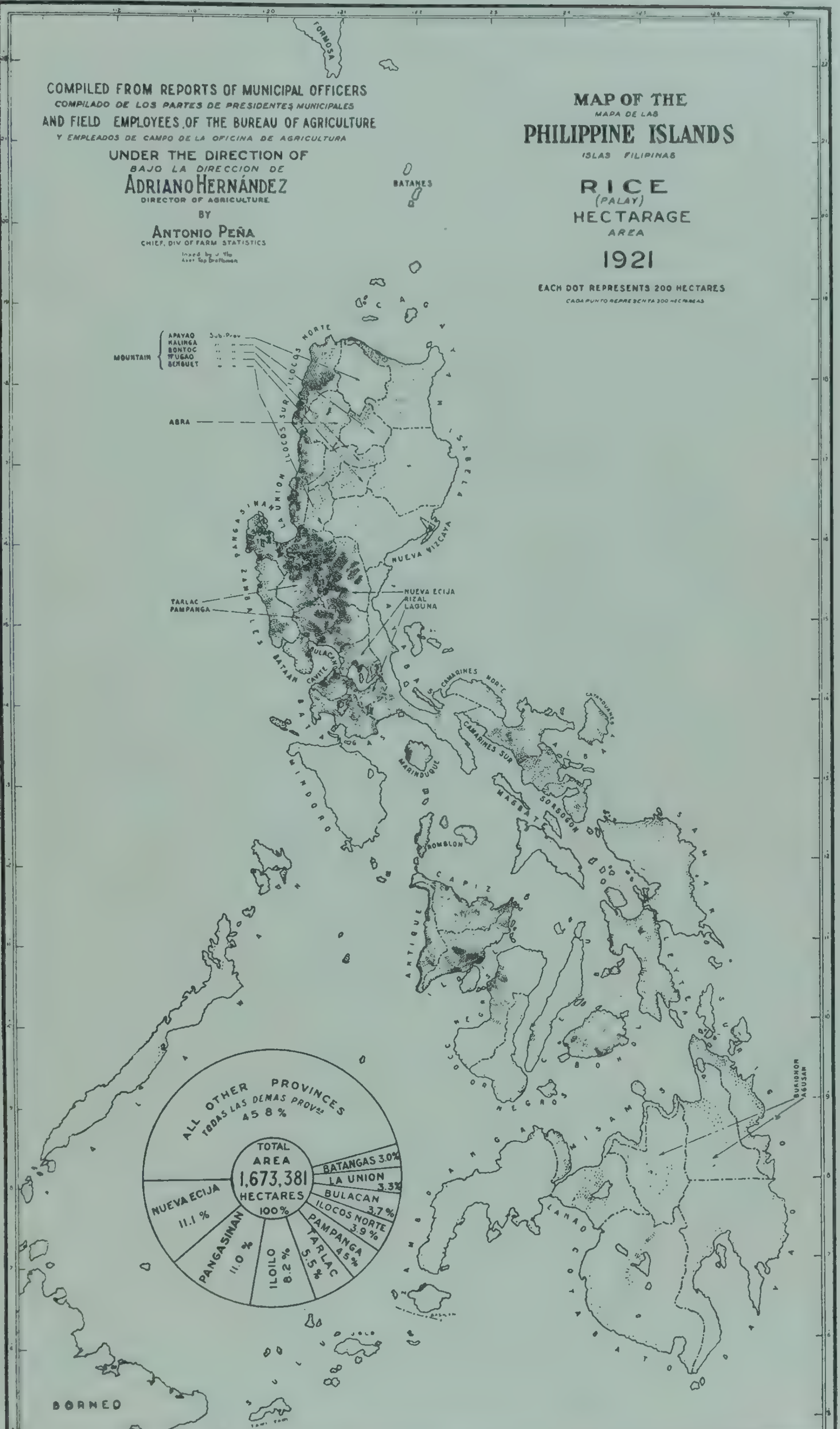
Despite these adverse conditions, the farmers broke, during the year, three new records, raising the largest crops of sugar, rice, and copra ever known in the Islands. Certainly this success was greatly influenced by the high prices that prevailed during the planting season of rice and sugar, but the yields per hectare cultivated secured were, for sugar, the largest ever obtained, and for rice surpassed only by the yield of 1918, which crop was favored by exceptionally good weather conditions. This proves *per se* how much better methods of farming are being practiced by our farmers.

The influence of the last war upon the agricultural prosperity of these Islands was again revealed by the considerable increase registered during the year in the total area cropped. The largest annual increase, 302,017 hectares, in the area planted to the six leading products (rice, sugar cane, coconuts, abaca, corn, and tobacco) was recorded in 1920, and the second largest, 238,645, in 1921. The latter figures indicate that the cultivated area was increased as much in one year as it had before in three, and the former, as it had in four.

Table I shows in detail this development in the area cropped and the worth of the produce, the annual per cent of increase or decrease and the total value of the products per hectare, since 1910.

TABLE I.—*Area and value of the six leading crops*

Year	Area	Per cent of increase or decrease	Value	Per cent of increase or decrease	Average value per hectare
	Hectares		*Pesos*		*Pesos*
1910	2,256,532		137,005,956		61
1911	2,148,238	— 5	152,501,515	+11	71
1912	2,303,875	+ 7	148,347,499	— 3	64
1913	2,361,483	+ 3	168,633,730	+14	71
1914	2,579,994	+ 9	163,496,249	— 4	63
1915	2,522,208	— 2	159,055,329	— 3	63
1916	2,531,701	+ 4	179,241,378	+13	71
1917	2,691,412	+ 6	244,179,473	+36	91
1918	2,918,590	+ 8	361,940,449	+48	124
1919	2,974,925	+ 2	458,698,576	+27	154
1920	3,276,942	+10	687,131,502	+50	210
1921	3,515,587	+ 7	403,258,251	—41	115


COMPILED FROM REPORTS OF MUNICIPAL OFFICERS
COMPILADO DE LOS PARTES DE PRESIDENTES MUNICIPALES
AND FIELD EMPLOYEES OF THE BUREAU OF AGRICULTURE
Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNÁNDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF, DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
RICE
(PALAY)
HECTARAGE
AREA
1921
EACH DOT REPRESENTS 200 HECTARES
FORMOSA
BATANES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
Sub-Prov.
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
ISABELA
NUEVA VIZCAYA
NUEVA ECIJA
RIZAL
LAGUNA
TARLAC
PAMPANGA
ZAMBALES
BULACAN
BATAAN
CAVITE
BATANGAS
TAYABAS
CAMARINES NORTE
CAMARINES SUR
CATANDUANES
ALBAY
SORSOGON
MASBATE
MARINDUQUE
MINDORO
ROMBLON
CAPIZ
ANTIQUE
ILOILO
OCC. NEGROS
NEGROS OR.
CEBU
BOHOL
SAMAR
LEYTE
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
SURIGAO
BUKIDNON
AGUSAN
JOLO
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROV.
45.8 %
TOTAL
AREA
1,673,381
HECTARES
100%
BATANGAS 3.0%
LA UNION 3.3%
BULACAN 3.7%
ILOCOS NORTE 3.9%
PAMPANGA 4.5%
TARLAC 5.5%
ILOILO 8.2%
PANGASINAN 11.0%
NUEVA ECIJA 11.1%

STANDARD CROPS

Rice.—Because of the restrictions placed in 1919 by the French Government on its exportation from Indo-China, the country upon which these Islands depend for making up most of its local shortage; because of the high prices that it has been commanding in recent years and because it is the national food of the Filipino people, the rice industry received unusual attention from the farmers last year.

Rains came generally late and when they did, they were too heavy for the young seedlings to resist, while the floods washed away many of the growing fields; but the farmers replanted the destroyed areas and worked with all their might to recoup their losses and their efforts were crowned with the greatest success registered in the History of the Philippines.

One million six hundred seventy three thousand three hundred and eighty-one hectares were planted during the year. This was 12.7 per cent greater than the area for last year, 33.9 per cent greater than the average of 1915–19, and 46.8 per cent greater than the pre-war average of 1910–14. Of said area, 1,132,668 hectares or 67.7 per cent was lowland rice. The total production was 3,110,890,500 liters or 41,478,540 cavans of rough rice which compares favorably with the preceding periods of 1920, 1915–19, and 1910–14, showing 14.1 per cent, 51.9 per cent, and 111.1 per cent of increase, respectively. Of this production, 2,273,106,300 liters (30,308,084 cavans) or 73.1 per cent was gathered from the lowlands and 837,784,200 liters (11,170,456 cavans) or 26.9 per cent, from the uplands. The value has, however, fell very considerably, 38.4 per cent from the value of the preceding year, for it was only ₱156,892,680.

Nueva Ecija, Pangasinan, Iloilo, Tarlac, Pampanga, Ilocos Norte, Bulacan, La Union, and Batangas, were the leading provinces in the order of their area cultivated. All together had 906,648 hectares or 54.2 per cent of the total area of the Philippines and the production was 1,982,126,175 liters (26,428,349 cavans) or 63.7 per cent of the total. Of these, 1,431,335,250 liters (19,084,470 cavans) were gathered from 594,120 hectares of lowland rice.

1 cavan of rough rice = 43.6 kilos.
1 cavan of cleaned rice = 57.5 kilos.

The total area cultivated in the Islands, the production, the average price, and the total value of this cereal since 1910, are given in the following table:

TABLE II.—*Rough rice*

Year	Area cultivated	Production	Average price per liter	Total value
	Hectares	*Liters*		
1910	1,192,141	1,414,431,450	₱0.039	₱55,765,849
1911	1,043,757	1,539,757,200	.040	61,759,589
1912	1,078,891	871,685,100	.046	39,981,288
1913	1,141,242	1,837,414,350	.032	57,939,799
1914	1,244,937	1,705,261,050	.034	57,261,760
1915	1,130,713	1,336,386,825	.037	49,207,978
1916	1,140,829	1,565,914,800	.036	55,923,821
1917	1,225,692	2,120,753,775	.038	81,377,812
1918	1,368,140	2,684,628,450	.050	135,163,375
1919	1,381,339	2,533,623,675	.074	188,614,588
1920	1,484,895	2,725,785,600	.093	254,855,385
1921	1,673,381	3,110,890,500	.050	156,892,680

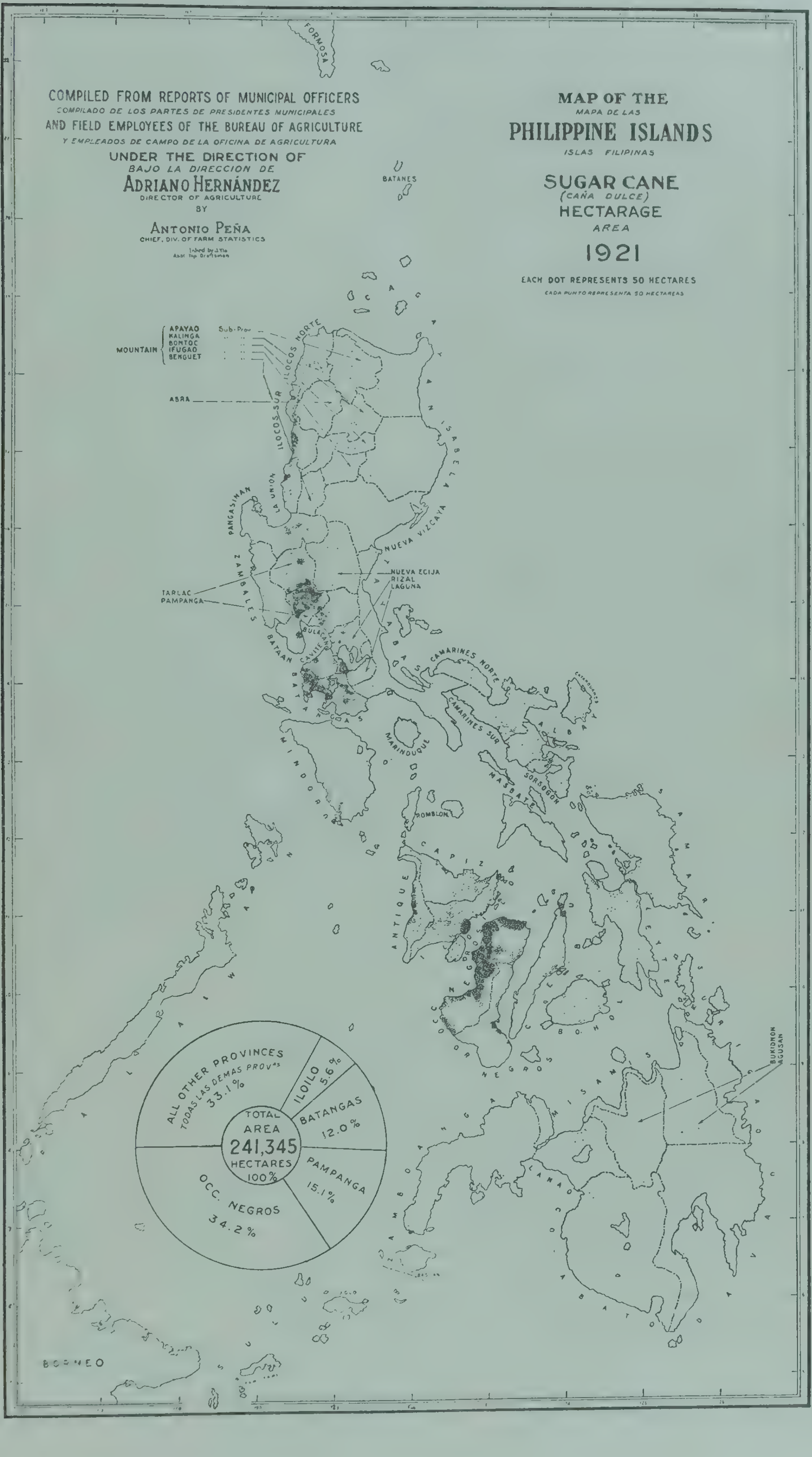
Cleaned rice

Year	Production	Average price per kilo	Total value
	Kilos		
1910	528,054,408	₱0.115	₱60,620,646
1911	574,842,688	.115	65,991,941
1912	325,429,104	.130	42,305,782
1913	685,968,024	.090	61,737,122
1914	636,630,792	.096	60,925,136
1915	498,917,748	.104	52,078,910
1916	584,608,192	.106	62,187,479
1917	791,748,607	.138	108,917,069
1918	1,004,007,385	.236	236,771,133
1919	947,534,047	.253	239,790,472
1920	1,019,399,503	.260	265,147,990
1921	1,163,422,455	.166	193,326,797

₱1.08 = $0.50.

Sugar cane.—Breaking all records heretofore made, sugar cane came after rice as the second crop of the Islands in value. The hectarage and the production of 1920–21 campaign were 22 per cent and 26 per cent, respectively, greater than the hectarage and production of the preceding year and this was due to the boom prices that this product commanded at the beginning of the planting season and the new centrals established.

From 241,345 hectares cultivated there were harvested 510,171,338 kilos of sugar, 24,562,505 kilos of panochas, 8,039,591 liters of basi, and 7,524,745 liters of molasses, all valued in the municipal markets at ₱96,378,980. Comparing these results with those obtained in the preceding campaign there is in favor of the 1920–21 crop an increase of 22 per cent in the area cultivated and 26 per cent in the production of sugars and panochas, but a loss of 39 per cent in value. The production of sugars by classes was as follows: Refined, 5,123,250 kilos; centrifugal, 179,156,637 kilos; muscovado, 325,891,451 kilos. A close com-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Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNÁNDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF, DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SUGAR CANE
(CAÑA DULCE)
HECTARAGE
AREA
1921
EACH DOT REPRESENTS 50 HECTARES
CADA PUNTO REPRESENTA 50 HECTAREAS
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVAS
33.1%
ILOILO 5.6%
BATANGAS 12.0%
PAMPANGA 15.1%
OCC. NEGROS 34.2%
TOTAL AREA 241,345 HECTARES 100%

parison of the quantities of the different classes of sugars obtained this year with those of the previous crop, reveals the influence of the centrals in the sugar industry of these Islands. During the 1919–20 campaign the quantity of refined sugar did not reach even 0.1 per cent, while this year it was exactly 1 per cent; the centrifugal sugar advanced from 21 per cent in 1919–20 to 35 per cent in 1920–21 and the muscovados fell from 79 per cent to 64 per cent, respectively. With the arrangements that are being made by the old centrals to increase their original capacity and the construction of the new centrals planned, there is no doubt that within a comparatively short time muscovado sugars will have no place in Philippine production, or if any, it will be trifling.

The prices in the municipal markets for this crop as compared with those of the preceding year were as follows: Refined, ₱0.51 per kilo or ₱32.47 per picul against ₱0.63 per kilo or ₱40 per picul; centrifugal, ₱0.23 per kilo or ₱14.24 per picul against ₱0.45 per kilo or ₱28.18 per picul; muscovados, ₱0.14 per kilo or ₱8.90 per picul against ₱0.35 per kilo or ₱22.45 per picul. Panochas were ₱0.19 per kilo or ₱11.96 per picul against ₱0.30 per kilo or ₱18.95 per picul.

Only four provinces were accountable for 67 per cent of the total area cultivated and 76 per cent of the production. They were Occidental Negros, Pampanga, Batangas, and Iloilo. These provinces turned out 141,600,748 kilos of centrifugal sugar and 243,884,916 kilos of muscovados.

The following table shows the area cultivated, production, and total value of all by-products of sugar cane since 1910.

TABLE III.—*Sugar cane in the Philippines*

Year	Area cultivated	Sugar	Panocha	Total value of sugar cane products
	Hectares	*Kilos*	*Kilos*	
1910	83,168	152,639,327	(1)	₱15,263,933
1911	120,313	243,924,574	(1)	24,392,457
1912	164,261	242,334,659	12,908,359	26,428,626
1913	176,118	291,386,825	21,664,663	25,698,450
1914	169,436	346,429,556	24,013,110	28,631,545
1915	173,092	360,176,309	21,926,350	33,212,488
1916	179,761	350,281,946	23,730,795	34,136,133
1917	185,931	362,338,084	23,460,746	38,704,708
1918	205,511	396,242,786	34,442,908	41,158,779
1919	200,199	379,127,229	32,145,430	74,462,819
1920	197,403	391,862,971	31,717,282	159,257,117
1921	241,345	510,171,338	24,562,505	96,378,980

[1] Sugar not classified prior to 1912.

1 picul — 63.25 kilos.

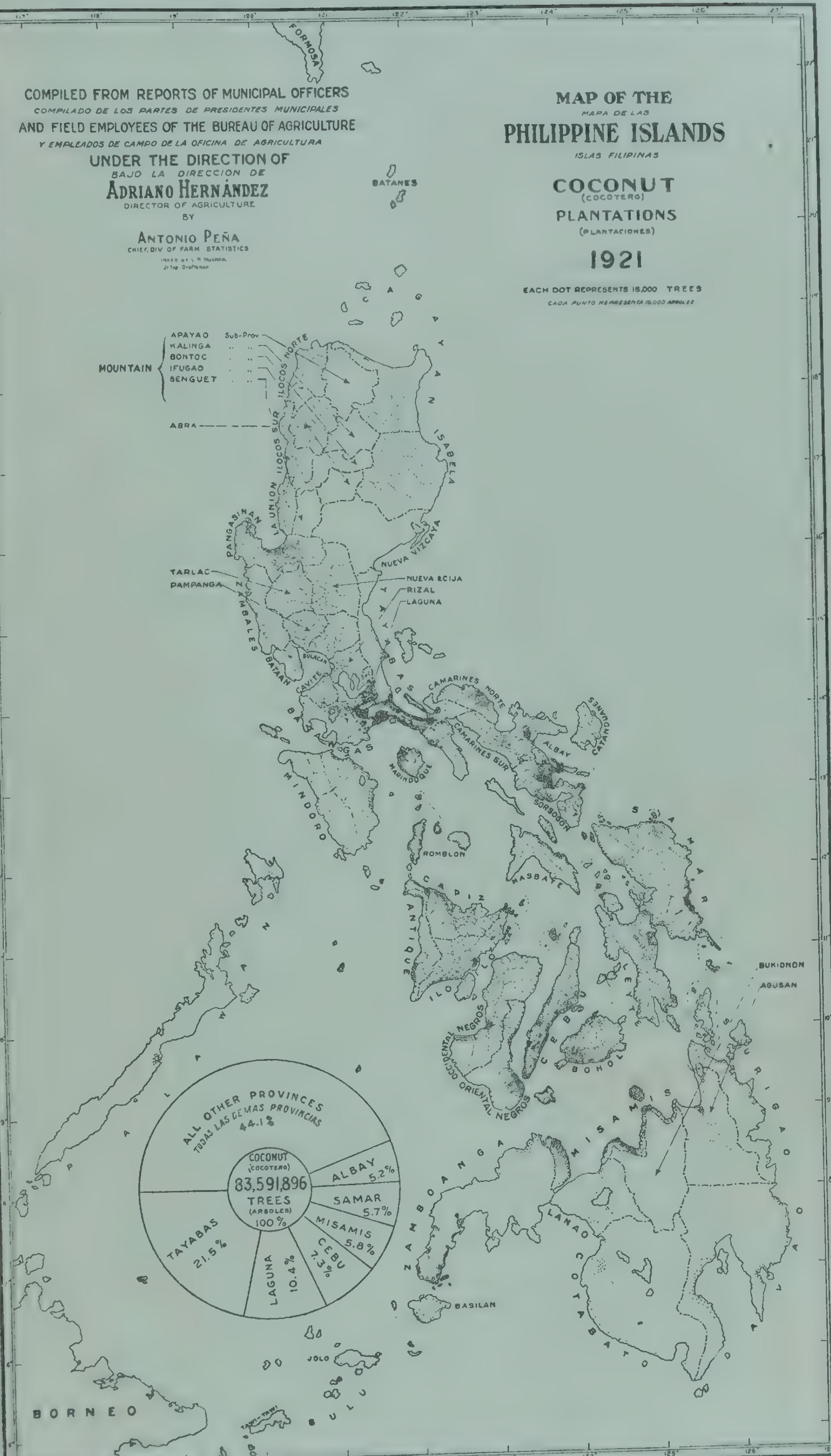
Coconuts.—In 1912, an unusually prolonged and pronounced period of drought followed by a series of destructive typhoons destroyed over one million and a half trees in the coconut plantations which caused a corresponding decrease in 1913 crop. Except for this poor year, every year since 1910 has shown a steady increase in the number of coconut trees and copra produced.

On June 30, 1921, there were in the Islands 83,591,896 trees cultivated, of which 46,459,181 or 55.6 per cent were bearing nuts, 550,327 or 0.6 per cent were distilling tuba and the rest were young trees. The production of nuts was 1,547,583,132. This was 2.5 per cent greater than the corresponding figure for 1919–20, but proportionately smaller in 6 per cent if compared with the larger yield per tree gathered the previous year with a smaller per cent of bearing trees; for the average amount of nuts gathered this year per tree was only 33 or 2 less than last season. This decrease was due to the damage done the plantations from the destructive typhoons registered in 1918–19 and 1919–20.

Of the total nuts gathered during the year, 92.8 per cent went to the making of copra, 1.8 per cent to the making of oil and 5.4 per cent were eaten fresh or cooked. There were 374,622,476 kilos or 5,922,885 piculs of copra, 2,706,723 liters of oil (home-made) and 103,854,736 liters of tuba. Of the copra produced, 181,022,575 kilos were sundried or 48.3 per cent of the total; 192,626,041 kilos were smoked copra or 51.4 per cent and 973,860 kilos were steamed copra or 0.3 per cent.

The prices of the different grades of copra and of the other by-products of coconuts as compared with those of the preceding year were as follows: Sundried copra, ₱0.15 per kilo against ₱0.31; smoked copra, ₱0.17 per kilo against ₱0.29; steamed copra, ₱0.11 against ₱0.30; fresh nuts, ₱4.73 per 100 against ₱6.70; coconut oil, ₱0.53 per liter against ₱0.59; tuba, ₱0.11 per liter against ₱0.14. Because of these lower prices, the total value of all coconut by-products was only ₱76,192,530 for last year, while the year before a smaller production brought to the farmer the respectable sum of ₱128,196,891.

The leading coconut producing provinces according to the number of trees cultivated were Tayabas, Laguna, Cebu, Misamis, Samar, and Albay, which have 55.9 per cent of the total number of trees planted in the Islands. Their combined production was 1,047,745,685 nuts and 258,324,005 kilos of copra or 68 per cent and 69 per cent, respectively, of the corresponding totals for the Islands.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Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNÁNDEZ
DIRECTOR OF AGRICULTURE
BY
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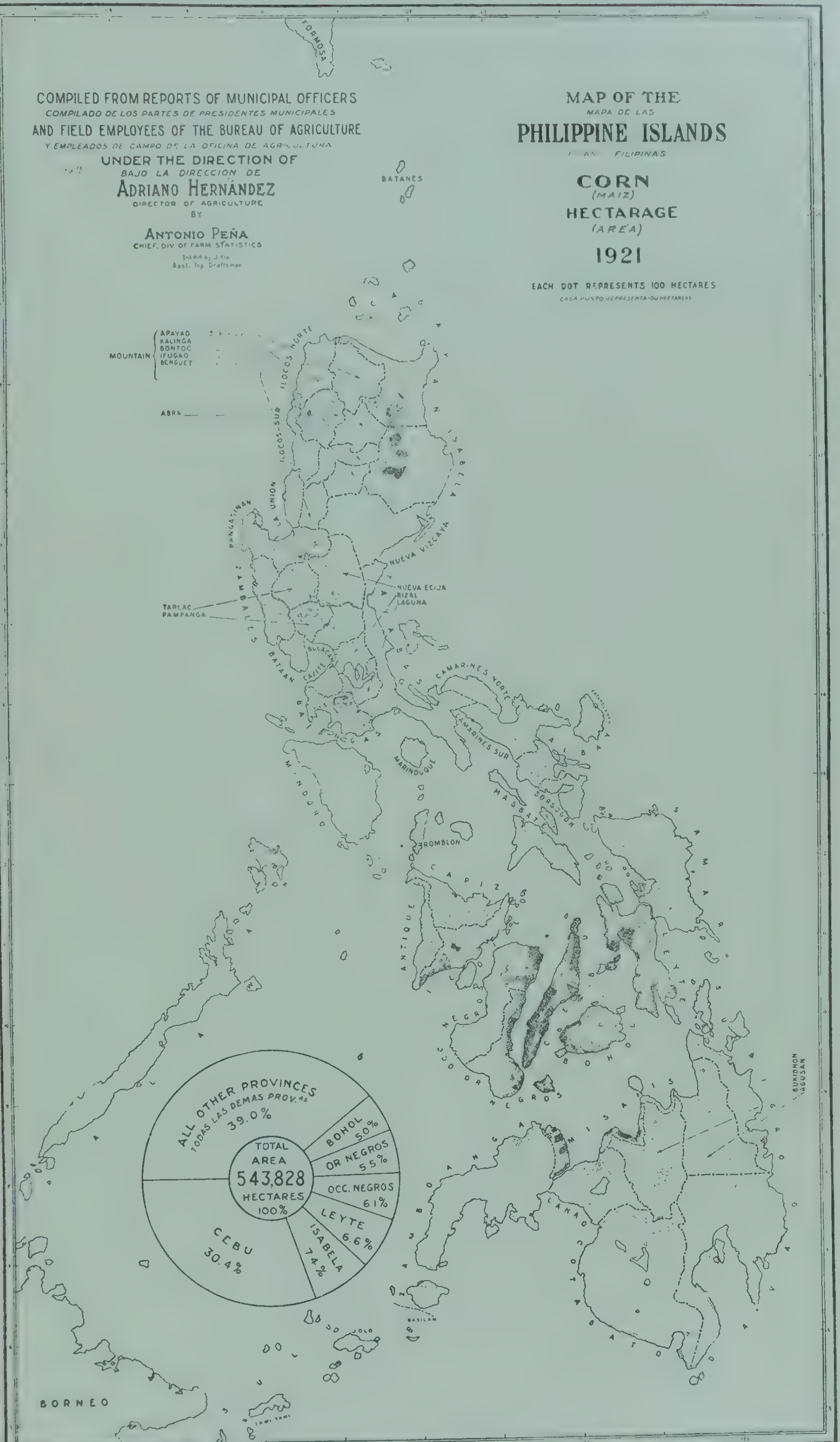
CHIEF, DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
COCONUT
(COCOTERO)
PLANTATIONS
(PLANTACIONES)
1921
EACH DOT REPRESENTS 15,000 TREES
CADA PUNTO REPRESENTA 15,000 ARBOLES
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
44.1%
COCONUT
(COCOTERO)
83,591,896
TREES
(ARBOLES)
100%
ALBAY 5.2%
SAMAR 5.7%
MISAMIS 5.8%
CEBU 7.3%
LAGUNA 10.4%
TAYABAS 21.5%
FORMOSA
BATANES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
Sub-Prov.
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
CAGAYAN
ISABELA
NUEVA VIZCAYA
NUEVA ECIJA
TARLAC
PAMPANGA
ZAMBALES
BATAAN
BULACAN
RIZAL
LAGUNA
CAVITE
TAYABAS
BATANGAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
CATANDUANES
SORSOGON
MARINDUQUE
MINDORO
ROMBLON
MASBATE
SAMAR
CAPIZ
ANTIQUE
ILOILO
NEGROS OCCIDENTAL
ORIENTAL NEGROS
CEBU
BOHOL
LEYTE
SURIGAO
BUKIDNON
AGUSAN
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
BASILAN
JOLO
SULU
TAWI-TAWI
PALAWAN
BORNEO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MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
FILIPINAS
CORN
(MAIZ)
HECTARAGE
(AREA)
1921
EACH DOT REPRESENTS 100 HECTARES
ALL OTHER PROVINCES
TODAS LAS DEMAS PROV.
39.0%
TOTAL
AREA
543,828
HECTARES
100%
BOHOL 5.0%
OR. NEGROS 5.5%
OCC. NEGROS 6.1%
LEYTE 6.6%
ISABELA 7.4%
CEBU 30.4%
FORMOSA
BATANES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
NUEVA VIZCAYA
NUEVA ECIJA
RIZAL
LAGUNA
TARLAC
PAMPANGA
ZAMBALES
BATAAN
BULACAN
CAVITE
CAMARINES NORTE
CAMARINES SUR
MARINDUQUE
MASBATE
SORSOGON
ROMBLON
CAPIZ
ANTIQUE
BOHOL
BUKIDNON
AGUSAN
LANAO
BASILAN
JOLO
BORNEO

TABLE IV

Year	Trees cultivated	Nuts gathered	Total value of coconut products
1910	32,838,544	937,927,927	₱26,161,629
1911	41,695,165	965,155,699	26,261,273
1912	46,136,349	1,041,181,904	35,926,543
1913	44,642,411	781,585,504	30,535,664
1914	49,190,368	591,266,399	24,651,764
1915	52,829,678	865,815,826	24,461,884
1916	54,153,847	735,275,751	24,430,955
1917	60,244,047	880,588,806	31,975,494
1918	67,120,399	1,506,796,110	56,533,793
1919	74,650,102	1,454,950,603	75,438,291
1920	79,406,104	1,509,504,293	128,196,891
1921	83,591,896	1,547,583,132	76,192,530

Year	Nuts consumed for food	Copra	Oil (home-made)	Tuba
		Kilos	*Liters*	*Liters*
1910	311,609,148	118,140,822	6,993,513	174,483,484
1911	154,980,726	118,323,114	6,602,966	37,649,880
1912	96,262,490	174,035,835	4,868,101	39,842,911
1913	147,981,014	116,699,818	5,010,540	42,145,874
1914	63,057,700	107,382,931	3,595,332	54,048,393
1915	72,441,158	171,573,963	3,175,626	51,372,213
1916	63,818,406	141,764,193	2,688,305	53,938,612
1917	64,586,492	186,510,962	2,623,687	43,674,587
1918	91,612,157	346,656,535	4,555,330	83,922,804
1919	75,358,583	349,384,855	5,142,213	100,315,522
1920	84,216,092	361,605,373	2,879,452	98,068,843
1921	83,556,120	374,622,476	2,706,723	103,854,736

Average prices

Year	Nuts, per 100	Copra, per kilo	Oil, per liter	Tuba, per liter
1910	₱3.00	₱0.15	₱0.30	₱0.05
1911	3.00	.15	.30	.05
1912	3.00	.17	.30	.05
1913	4.00	.18	.30	.05
1914	4.00	.16	.34	.06
1915	2.90	.11	.21	.06
1916	3.41	.13	.26	.05
1917	3.73	.14	.32	.05
1918	3.63	.13	.30	.07
1919	4.39	.17	.36	.10
1920	6.70	.30	.59	.14
1921	4.73	.16	.53	.11

Corn.—This product held the distinction of occupying fourth place among the leading crops of the Philippines, in spite of having registered a smaller production than last year.

With too strong winds and excessive heat in Luzon and heavy rains in Visayas, the corn growers obtained 7.8 per cent less yield per hectare cultivated but planted an area 1.2 per cent larger than that for the preceding year.

Five hundred and forty-three thousand eight hundred and twenty-eight hectares were put under cultivation and yielded 516,299,700 liters of shelled corn, which were sold for ₱38,187,266. The area was the largest ever planted, it being 26

per cent larger than the average area for 1915–19 and 45 per cent larger than that for 1910–14. The production was larger, too, by 12 per cent than the average for 1915–19 and by 79 per cent than that for 1910–14, but was exceeded by 7 per cent in 1919–20 and by 0.4 per cent in 1914–15.

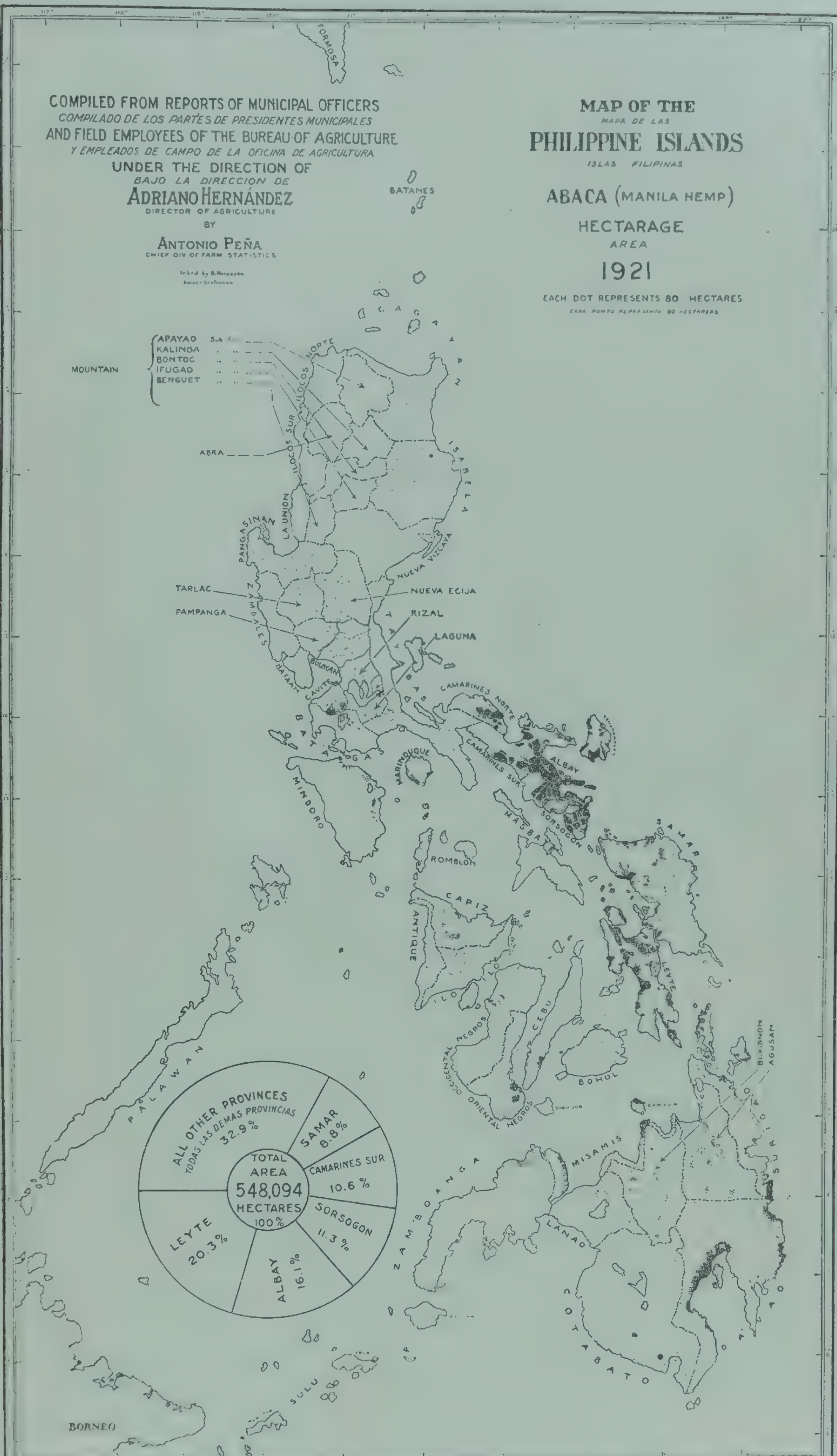
Sixty-one and nine-tenths per cent of the total area cultivated and 64.5 per cent of the total production were carried by six provinces alone—Cebu, Isabela, Leyte, Occidental Negros Oriental Negros, and Bohol.

TABLE V

Year	Hectares	Liters	Price per liter	Value
1910	288,268	185,068,056	₱0.046	₱8,661,185
1911	302,516	186,404,700	.047	8,723,740
1912	340,196	274,964,929	.047	12,868,359
1913	383,709	325,450,460	.047	15,231,082
1914	421,309	469,961,119	.034	15,873,804
1915	443,048	518,126,873	.031	16,067,658
1916	432,766	496,270,874	.030	14,723,962
1917	428,293	473,659,035	.037	17,639,800
1918	418,386	397,177,773	.053	21,372,123
1919	430,715	426,456,940	.087	37,591,423
1920	537,135	552,907,350	.092	50,910,867
1921	543,828	516,299,700	.074	38,187,266

Abaca.—This important Philippine fiber used to hold second place among the leading crops of the Islands in the order of value of production; but was ousted in 1919 by sugar cane and coconuts and fell to fourth place in 1920, and now, passed even by corn, occupies fifth place. This is due to the distressing fall in prices, which began declining the year before the end of the war when the prices for all other articles advanced tremendously. As a result of this, and of the slight demand abroad for hard fibers, and because of local climatic disturbances, many planters turned their attention to other paying crops and many of those went further by planting with rice, corn or sugar cane the areas destroyed by the typhoons or dried up by the heat of the season. Though this may appear unwise, for abaca is, on account of the universal demand for good rope, a safe crop that will soon be restored to its normal rank, and therefore become again the principal source of prosperity of these Islands, it is a fact that growers confine their attention to the production of those crops that the market demands at the moment rather than those which though staple will bring them only a small income at the time, no matter if by so doing they trespass beyond the limits set by physical and biological laws.

The area under cultivation of this product this year was 548,094 hectares which was 2 per cent smaller than the year before. The greatest decrease was registered in the average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ADRIANO HERNÁNDEZ
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BY
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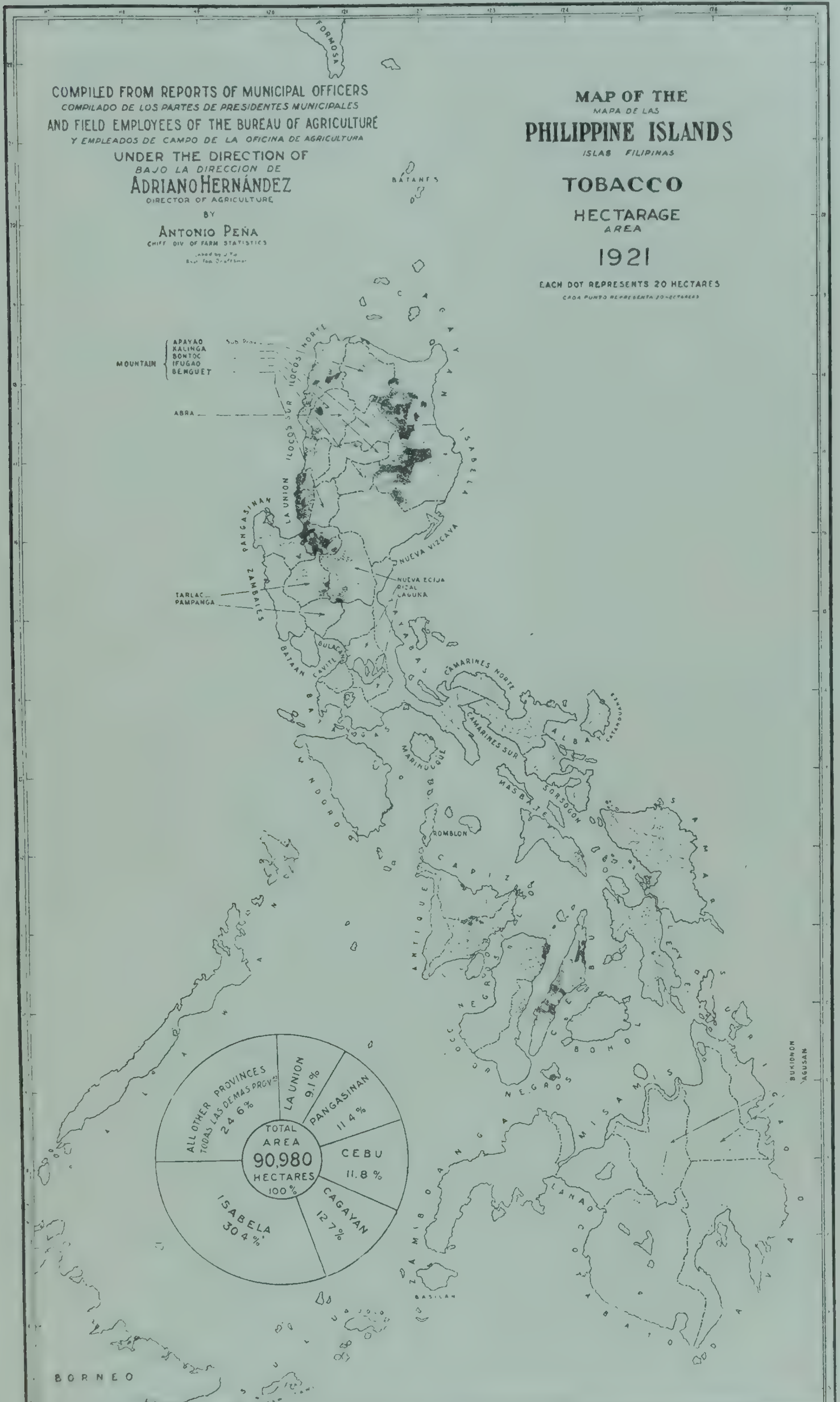
CHIEF DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
ABACA (MANILA HEMP)
HECTARAGE
AREA
1921
EACH DOT REPRESENTS 80 HECTARES
FORMOSA
BATANES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
ILOCOS NORTE
ILOCOS SUR
CAGAYAN
ISABELA
LA UNION
PANGASINAN
NUEVA VIZCAYA
TARLAC
PAMPANGA
NUEVA ECIJA
RIZAL
LAGUNA
ZAMBALES
BULACAN
BATAAN
CAVITE
BATANGAS
TAYABAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
SORSOGON
MARINDUQUE
MINDORO
MASBATE
ROMBLON
SAMAR
CAPIZ
ANTIQUE
ILOILO
LEYTE
CEBU
NEGROS OCCIDENTAL
NEGROS ORIENTAL
BOHOL
PALAWAN
MISAMIS
BUKIDNON
AGUSAN
SURIGAO
ZAMBOANGA
LANAO
COTABATO
DAVAO
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
32.9%
SAMAR 8.8%
CAMARINES SUR 10.6%
SORSOGON 11.3%
ALBAY 16.1%
LEYTE 20.3%
TOTAL AREA
548,094
HECTARES
100%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MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
TOBACCO
HECTARAGE
AREA
1921
EACH DOT REPRESENTS 20 HECTARES
ALL OTHER PROVINCES
TODAS LAS DEMAS PROV.
24.6%
LA UNION
9.1%
PANGASINAN
11.4%
CEBU
11.8%
CAGAYAN
12.7%
ISABELA
30.4%
TOTAL
AREA
90,980
HECTARES
100%
FORMOSA
BATANES
CAGAYAN
ISABELA
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
NUEVA VIZCAYA
NUEVA ECIJA
RIZAL
LAGUNA
TARLAC
PAMPANGA
ZAMBALES
BULACAN
BATAAN
CAVITE
TAYABAS
BATANGAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
CATANDUANES
SORSOGON
MASBATE
MARINDUQUE
MINDORO
ROMBLON
CAPIZ
ANTIQUE
SAMAR
LEYTE
CEBU
BOHOL
NEGROS
SURIGAO
BUKIDNON
AGUSAN
MISAMIS
LANAO
ZAMBOANGA
COTABATO
DAVAO
BASILAN
BORNEO

yield per hectare and consequently in the total production, which were 385 kilos and 108,353,530 kilos, respectively. This was 34.4 per cent smaller than that of the preceding period and the smallest production in the record of twelve years of the Bureau of Agriculture. With such a considerable reduction in the total output and with the lowest quotation registered in the last five years, it is no wonder that the value was only ₱26,829,221 or 57.5 per cent less than that obtained last year which was 3 per cent less than for 1918–19, which in turn was 30 per cent smaller than that for 1917–18, when the total value of the abaca reached its higest mark.

The principal abaca producing provinces in the order of hectarage are Leyte, Albay, Sorsogon, Camarines Sur, and Samar. These have altogether 367,366 hectares or 67 per cent of the total abaca area cultivated of the Islands and produced this year 72,432,870 kilos of fiber or 67 per cent of the total production.

TABLE VI

Year	Hectares	Kilos	Price per kilo	Value
1910	475,136	168,452,144	₱0.16	₱26,952,343
1911	404,160	171,879,598	.16	27,500,736
1912	432,804	159,473,376	.18	28,705,208
1913	368,211	140,520,332	.23	32,319,676
1914	437,470	137,635,558	.22	29,968,009
1915	457,865	154,192,492	.20	30,420,742
1916	448,663	152,756,278	.28	42,767,338
1917	488,500	160,953,355	.39	63,598,136
1918	512,508	166,863,644	.55	92,493,224
1919	515,563	148,340,800	.44	65,006,006
1920	559,356	165,081,488	.38	63,058,847
1921	548,094	108,353,530	.25	26,829,221

Tobacco.—With a decrease of 10 per cent in the area cultivated and 18.7 per cent in the production, tobacco came sixth in rank, due to the causes indicated for abaca, that is, low prices, drought and heavy rains, and for the same reasons part of the area that was used for planting tobacco was this year used for rice or sugar cane.

The area cultivated was only 90,980 hectares yielding 52,799,030 kilos of leaf which were valued in the municipal markets at ₱8,777,574, or at the rate price of 17 cents per kilo.

Despite these unfavorable results, the area planted for this year was 39.4 per cent greater than the average for 1915–19 and 46.9 per cent greater than that for 1910–14; while the production was larger by 7.1 per cent and 50 per cent, respectively.

Practically three-fourths of the total area and above four-fifths of the total production was planted and gathered in only five provinces, to wit, Isabela, Cagayan, Cebu, Pangasinan, and

La Union. During the year these provinces put under cultivation 68,023 hectares and raised 43,999,966 kilos.

TABLE VII

Year	Hectares	Kilos	Price per kilo	Value
1910	53,626	28,006,778	₱0.15	₱4,201,017
1911	69,016	25,518,132	.15	3,827,720
1912	57,041	29,583,169	.15	4,437,475
1913	68,991	46,060,390	.15	6,909,059
1914	60,890	46,731,463	.15	7,109,367
1915	53,342	38,302,964	.15	5,684,579
1916	58,913	41,139,174	.18	7,259,169
1917	61,776	48,928,621	.22	10,883,523
1918	78,443	61,555,322	.25	15,219,155
1919	73,859	56,497,748	.31	17,585,449
1920	101,123	64,893,534	.41	26,765,947
1921	90,980	52,799,030	.17	8,777,574

Maguey.—Not even as a substitute for higher priced fibers has maguey escaped from the consequences of the present economic and climatological disturbances that affected all of our products; and thus as this product registered last year the highest per cent of increase, it has this year registered the highest per cent of decrease.

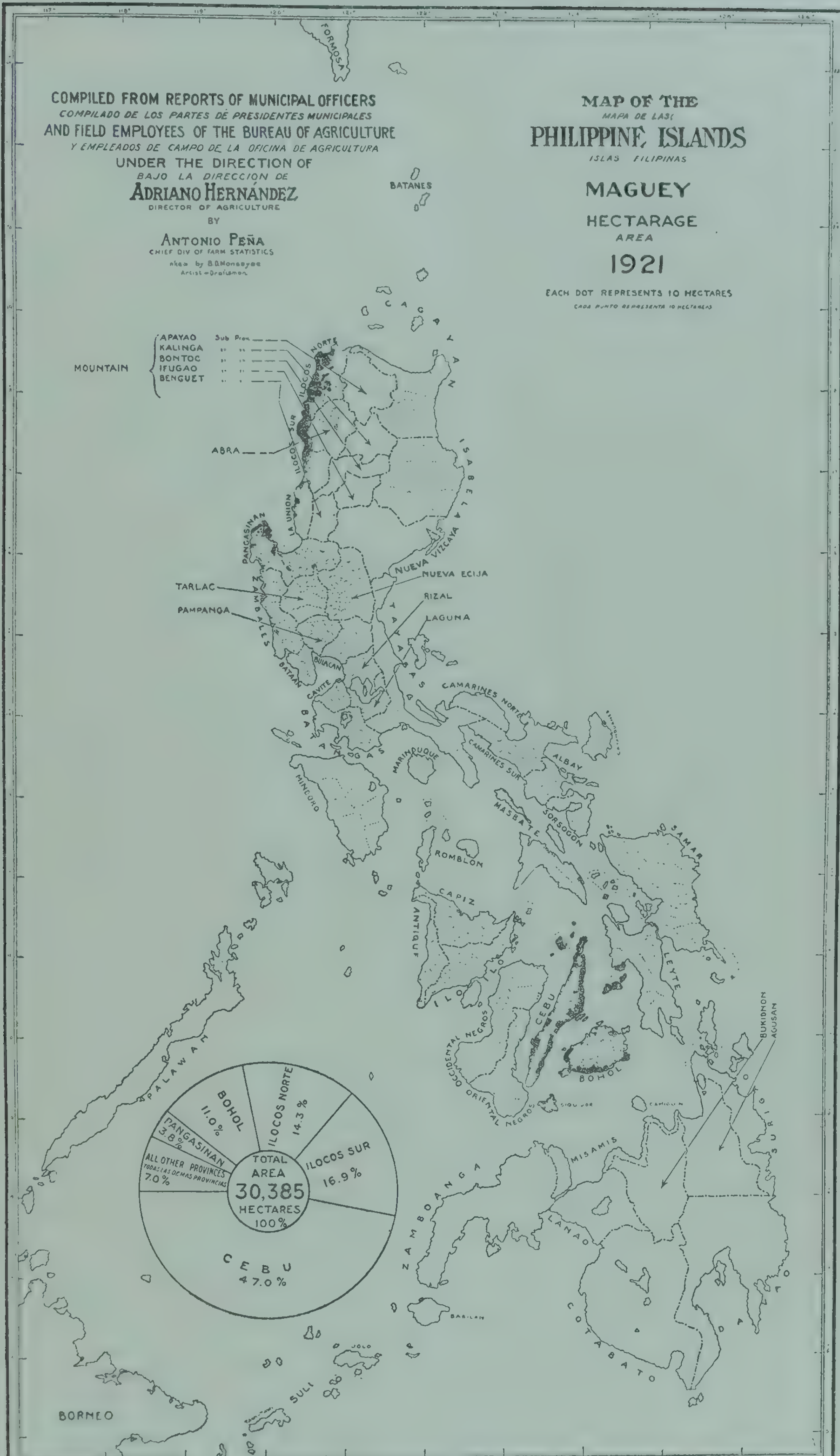
The hectarage of last year was reduced by 0.6 per cent, the production by 49.50 per cent and the total value by 69.1 per cent or in other words were reduced to 30,385 hectares, 9,177,470 kilos, and ₱1,054,261, respectively.

Leading in the cultivation of this fiber are Cebu, Ilocos Sur, Ilocos Norte, Bohol, and Pangasinan. Their aggregate area last year was 28,658 hectares or 94 per cent of the total area and the corresponding production was 8,981,745 kilos or 97.9 per cent of the entire production.

TABLE VIII

Year	Hectares	Kilos	Price per kilo	Value
1912	8,598	4,628,331	₱0.12	₱555,399
1913	9,283	3,619,976	.13	470,596
1914	18,218	7,583,802	.11	860,754
1915	19,218	6,315,632	.10	622,587
1916	30,804	13,389,722	.13	1,747,263
1917	28,099	17,190,019	.19	3,363,381
1918	32,601	16,664,736	.22	3,707,213
1919	28,465	12,318,392	.16	1,919,750
1920	30,567	18,178,050	.19	3,407,959
1921	30,385	9,177,470	.11	1,054,261

Cacao and coffee.—The figures for these two crops go back as far as 1914 and since then, both crops have registered a steady increase, except for 1916 and 1917 when the production declined due to the prolonged drought of 1915. For cacao alone the in-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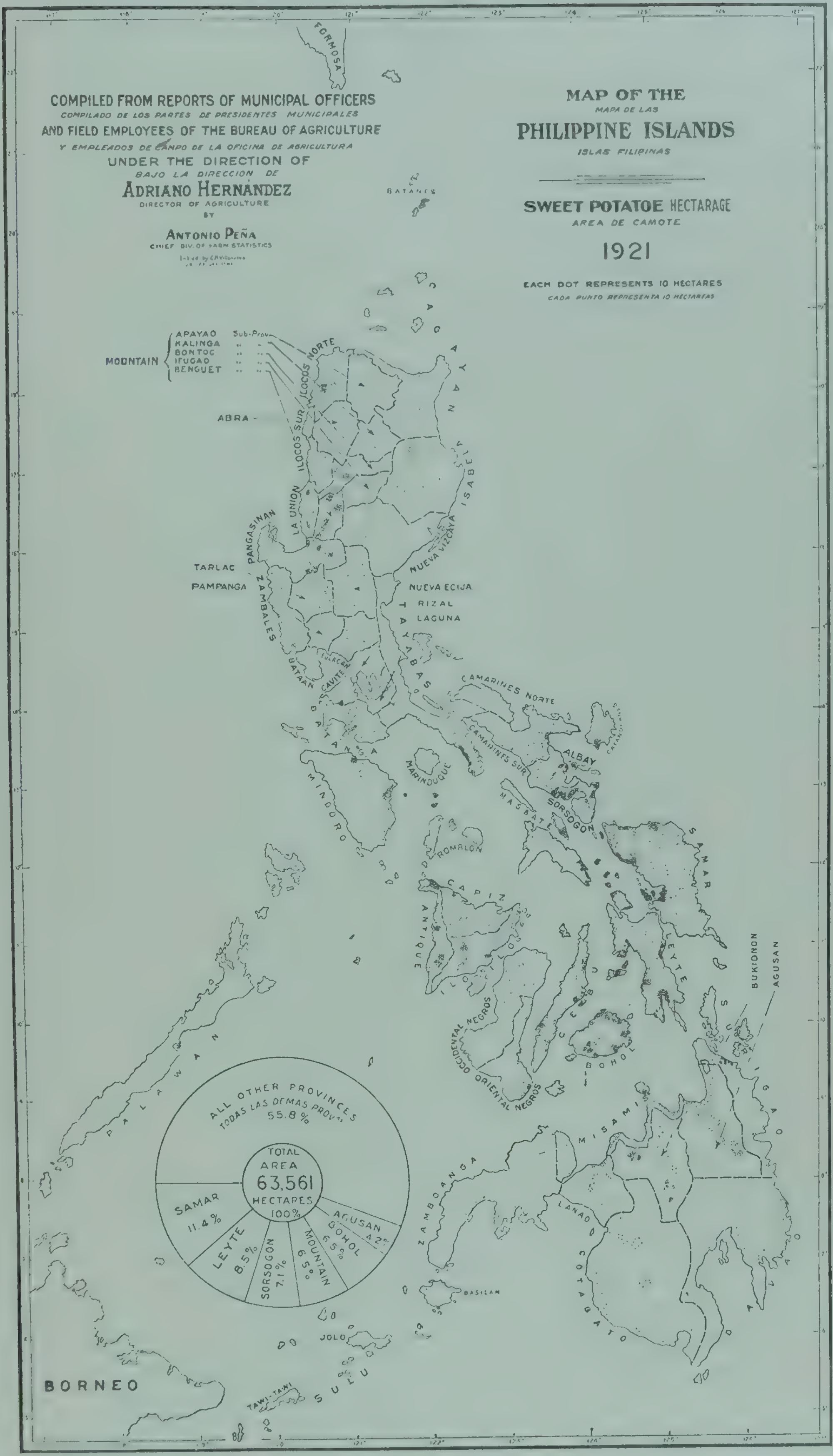
AND FIELD EMPLOYEES OF THE BUREAU OF AGRICULTURE
Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNÁNDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF DIV OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
MAGUEY
HECTARAGE
AREA
1921
EACH DOT REPRESENTS 10 HECTARES
FORMOSA
BATANES
CAGAYAN
MOUNTAIN
APAYAO Sub Prov.
KALINGA
BONTOC
IFUGAO
BENGUET
ILOCOS NORTE
ILOCOS SUR
ABRA
ISABELA
LA UNION
PANGASINAN
NUEVA VIZCAYA
NUEVA ECIJA
TARLAC
PAMPANGA
ZAMBALES
RIZAL
LAGUNA
BULACAN
BATAAN
CAVITE
TAYABAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
SORSOGON
BATANGAS
MARINDUQUE
MINDORO
MASBATE
SAMAR
ROMBLON
CAPIZ
ANTIQUE
ILOILO
LEYTE
CEBU
BOHOL
OCCIDENTAL NEGROS
ORIENTAL NEGROS
PALAWAN
BUKIDNON
AGUSAN
SURIGAO
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
BASILAN
JOLO
SULU
BORNEO
BOHOL 11.0%
ILOCOS NORTE 14.3%
PANGASINAN 3.8%
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
7.0%
TOTAL AREA 30,385 HECTARES 100%
ILOCOS SUR 16.9%
CEBU 47.0%



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AND FIELD EMPLOYEES OF THE BUREAU OF AGRICULTURE
Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
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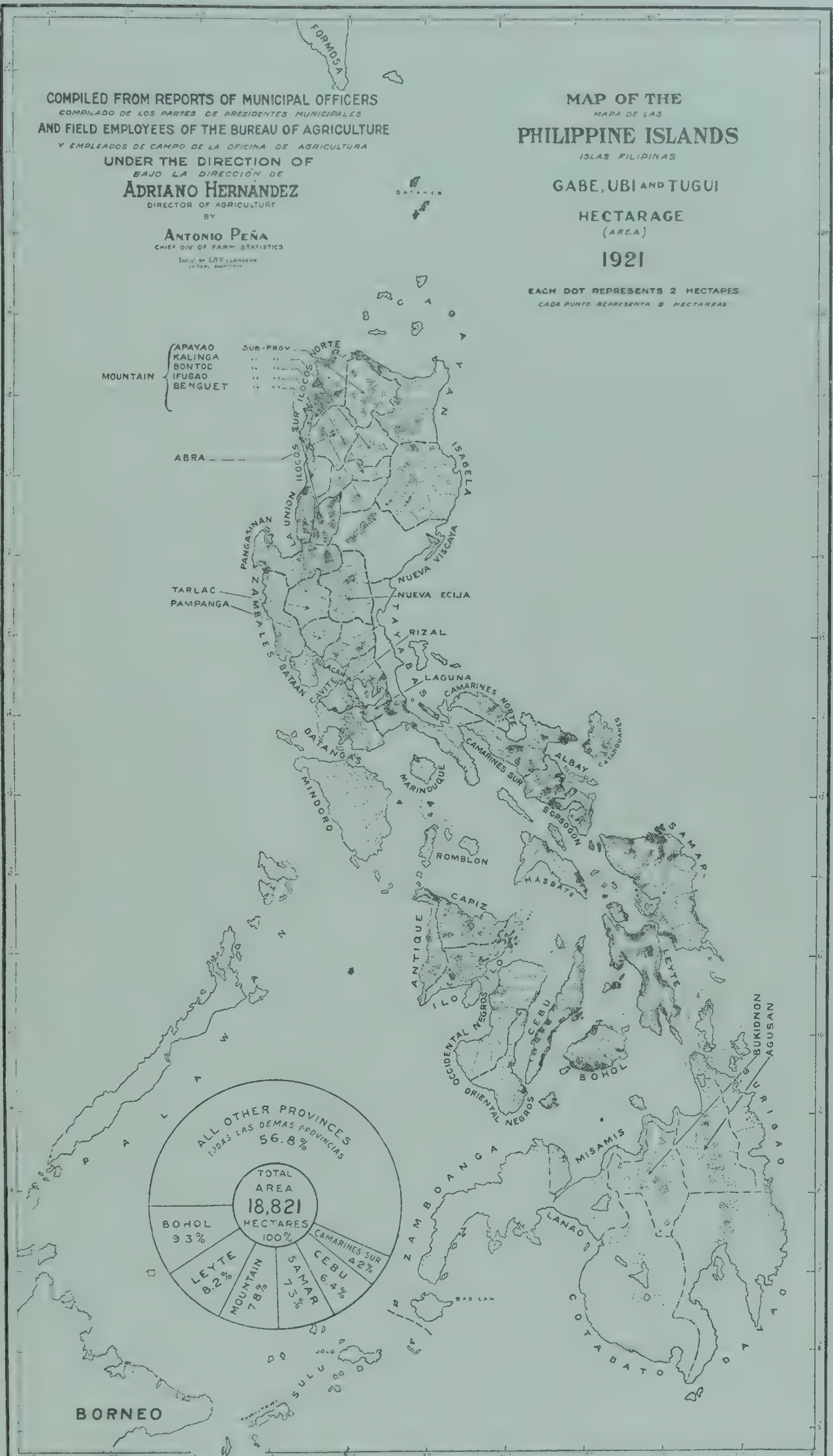
ADRIANO HERNANDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SWEET POTATOE HECTARAGE
AREA DE CAMOTE
1921
EACH DOT REPRESENTS 10 HECTARES
CADA PUNTO REPRESENTA 10 HECTAREAS
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVS.
55.8%
TOTAL AREA
63,561
HECTARES
100%
SAMAR 11.4%
LEYTE 8.5%
SORSOGON 7.1%
MOUNTAIN 6.5%
BOHOL 6.5%
AGUSAN 4.2%
FORMOSA
BATANES
CAGAYAN
ISABELA
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
Sub-Prov.
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
NUEVA VIZCAYA
TARLAC
PAMPANGA
ZAMBALES
NUEVA ECIJA
RIZAL
LAGUNA
TAYABAS
BULACAN
BATAAN
CAVITE
BATANGAS
CAMARINES NORTE
CAMARINES SUR
CATANDUANES
ALBAY
SORSOGON
MARINDUQUE
MINDORO
MASBATE
ROMBLON
CAPIZ
ANTIQUE
ILOILO
SAMAR
LEYTE
CEBU
BOHOL
OCCIDENTAL NEGROS
ORIENTAL NEGROS
PALAWAN
SURIGAO
BUKIDNON
AGUSAN
MISAMIS
LANAO
ZAMBOANGA
COTABATO
DAVAO
BASILAN
JOLO
SULU
TAWI-TAWI
BORNEO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AND FIELD EMPLOYEES OF THE BUREAU OF AGRICULTURE
Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCIÓN DE
ADRIANO HERNÁNDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF DIV OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
GABE, UBI AND TUGUI
HECTARAGE
(AREA)
1921
EACH DOT REPRESENTS 2 HECTARES
CADA PUNTO REPRESENTA 2 HECTAREAS
FORMOSA
BATANES
CAGAYAN
MOUNTAIN
APAYAO SUB-PROV.
KALINGA
BONTOC
IFUGAO
BENGUET
ILOCOS NORTE
ILOCOS SUR
ABRA
ISABELA
LA UNION
NUEVA VISCAYA
PANGASINAN
TARLAC
PAMPANGA
ZAMBALES
NUEVA ECIJA
TAYABAS
RIZAL
BULACAN
BATAAN
CAVITE
LAGUNA
CAMARINES NORTE
CATANDUANES
BATANGAS
MARINDUQUE
CAMARINES SUR
ALBAY
MINDORO
SORSOGON
SAMAR
ROMBLON
MASBATE
CAPIZ
ANTIQUE
ILOILO
LEYTE
CEBU
OCCIDENTAL NEGROS
ORIENTAL NEGROS
BOHOL
BUKIDNON
AGUSAN
SURIGAO
MISAMIS
PALAWAN
ZAMBOANGA
LANAO
COTABATO
DAVAO
BASILAN
JOLO
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
56.8%
TOTAL AREA
18,821
HECTARES
100%
BOHOL 9.3%
LEYTE 8.2%
MOUNTAIN 7.8%
SAMAR 7.3%
CEBU 6.4%
CAMARINES SUR 4.2%

crease in 1920–21 in the amount harvested was 57 per cent as compared with the corresponding harvest of 1913–14 and that of coffee was 70 per cent, or a total output of 888,940 kilos and 1,062,298 kilos, respectively. However, these amounts are insignificant, for the country is actually importing twice as much of both as it raises and there is every year an increase in their consumption.

TABLE IX.—*Cacao*

Year	Trees planted	Kilos	Value
1914	1,868,864	565,802	₱354,057
1915	1,869,685	625,611	398,991
1916	1,719,534	558,357	345,059
1917	1,618,010	537,335	338,500
1918	1,827,923	566,200	520,670
1919	1,853,183	572,740	535,053
1920	1,871,700	823,500	924,700
1921	1,656,253	888,940	1,267,700

TABLE X.—*Coffee*

Year	Trees planted	Kilos	Value
1914	1,969,996	626,408	₱302,771
1915	2,098,200	694,864	342,153
1916	2,110,974	752,196	361,754
1917	1,650,295	594,620	281,590
1918	1,920,571	721,855	445,983
1919	1,931,580	717,233	514,338
1920	2,015,200	998,800	823,800
1921	2,096,487	1,062,298	1,054,385

Miscellaneous field crops and vegetables.—Great efforts were exerted last year to diminish the cost of living by producing at home large quantities of food substitutes and these efforts met with great success according to the returns obtained for the crops listed below.

One hundred and forty-seven thousand four hundred and eighty-three hectares were planted to these different crops and yielded an aggregate amount of 316,201,668 kilos of foodstuffs which were valued in the municipal markets at ₱11,081,025. Compared with the results obtained in the preceding year, there was a decrease of 1 per cent in the area cultivated and of 12 per cent in the total value, but an increase of 18 per cent in the production.

The principal crops were sweet potatoes, valued at over ₱3,000,000; mongo and gabi worth over ₱1,000,000 each; and tomatoes, ubi, eggplants, cassava, and beans, over half-million pesos each.

TABLE XI

Crops	Hectares	Kilos	Value
Sweet potatoes	63,561.20	191,022,005	₱3,240,811
Mongo	12,671.10	11,163,523	1,747,882
Gabi	10,016.90	38,703,956	1,240,397
Tomatoes	8,410.60	8,383,569	838,177
Ubi	5,972.90	13,163,324	767,406
Eggplants	11,867.20	7,980,439	746,430
Cassava	15,077.60	29,383,654	657,210
Beans	8,690.80	2,481,710	546,736
Peanuts	5,151.50	1,807,932	477,105
Radish	1,792.00	4,029,678	395,219
Cabbages	1,118.80	1,778,119	262,867
Tugui	2,830.90	6,137,004	140,122
Irish potatoes	322.40	166,755	20,663
Total	147,483.90	316,201,668	11,081,025

Fruit production.—The fruit industry in these Islands is in general greatly neglected and in fact there are very few plantations that are entitled to that designation. In spite of this, the production for the year brought to the growers the respectable amount of ₱33,561,728 which, compared with the previous year, shows an increase of 32 per cent.

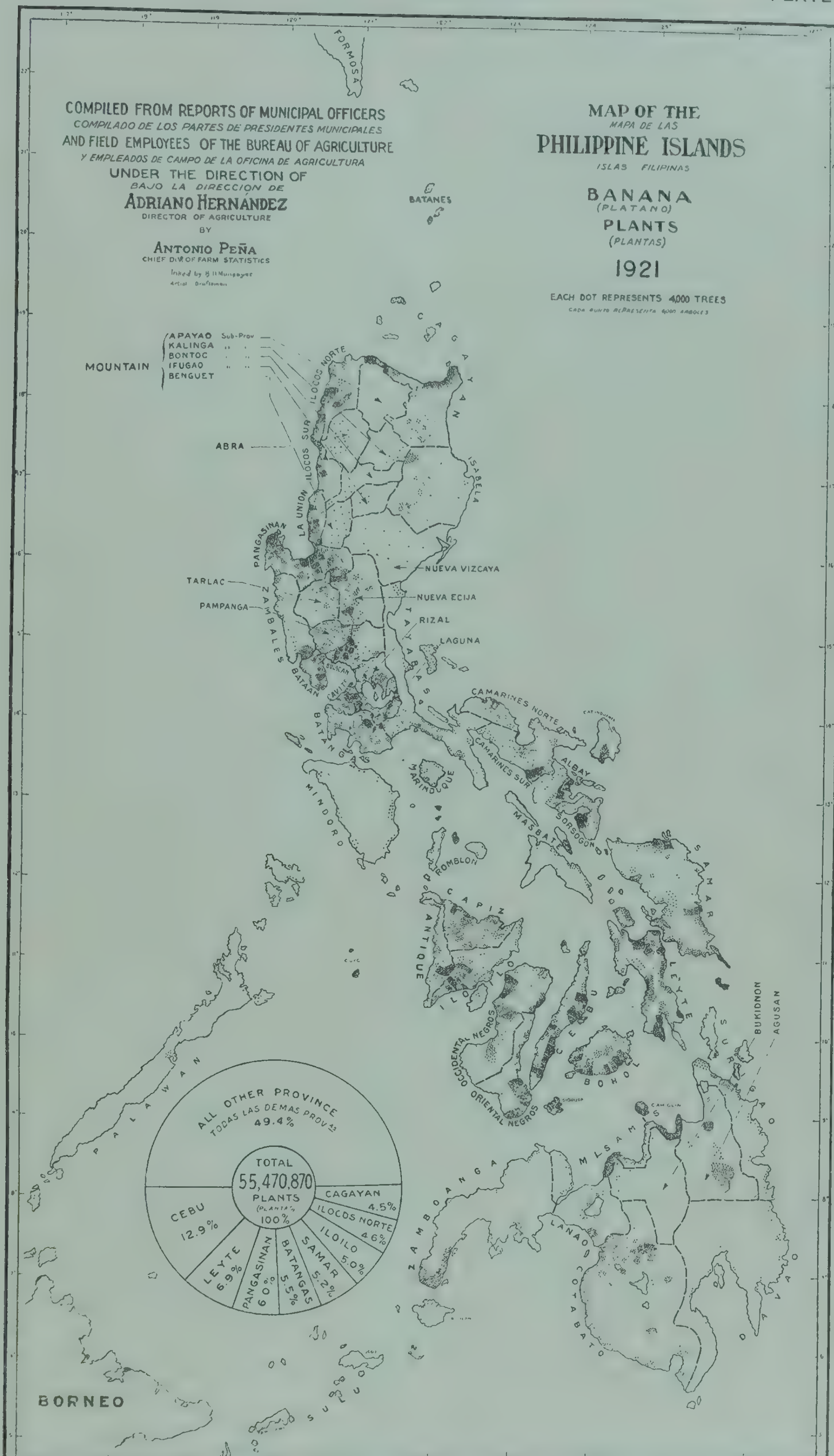
Among the leading fruits, banana and mangoes registered the greatest increase in both production and value although the latter decrease as to the number of trees planted.

TABLE XII

Fruits	Number of trees	Production	Value
Bananas	55,470,870	[a] 53,652,382	₱24,759,081
Mangoes	566,349	[b] 126,510,281	4,693,904
Papaya	3,594,400	[b] 51,031,875	1,236,973
Lanzones	139,005	....	828,993
Pilinut	275,996	[c] 3,652,795	436,403
Pineapples	8,300,254	[b] 6,132,266	336,632
Mandarin	356,007	[b] 19,730,366	267,197
Guanabano	603,422	[b] 7,232,238	265,110
Orange	209,447	[b] 8,767,845	229,761
Ates	1,225,486	[b] 15,400,513	225,908
Pomelo	212,680	[b] 4,475,038	105,656
Anonas	376,119	[b] 6,757,398	102,357
Chicos	50,296	[b] 6,663,420	73,753
Total			33,561,728

[a] Bunches. [b] Fruits. [c] Kilos.

Other crops.—These include castor beans, lumbang or candlenuts, kapok, and rubber. The first three named are more or less widely distributed in the Islands, but as in the case of fruits and of other nuts, their cultivation on a commercial basis is almost nil; while rubber is mostly confined to the provinces of Zamboanga and Davao, in Mindanao, where some large plantations can be found.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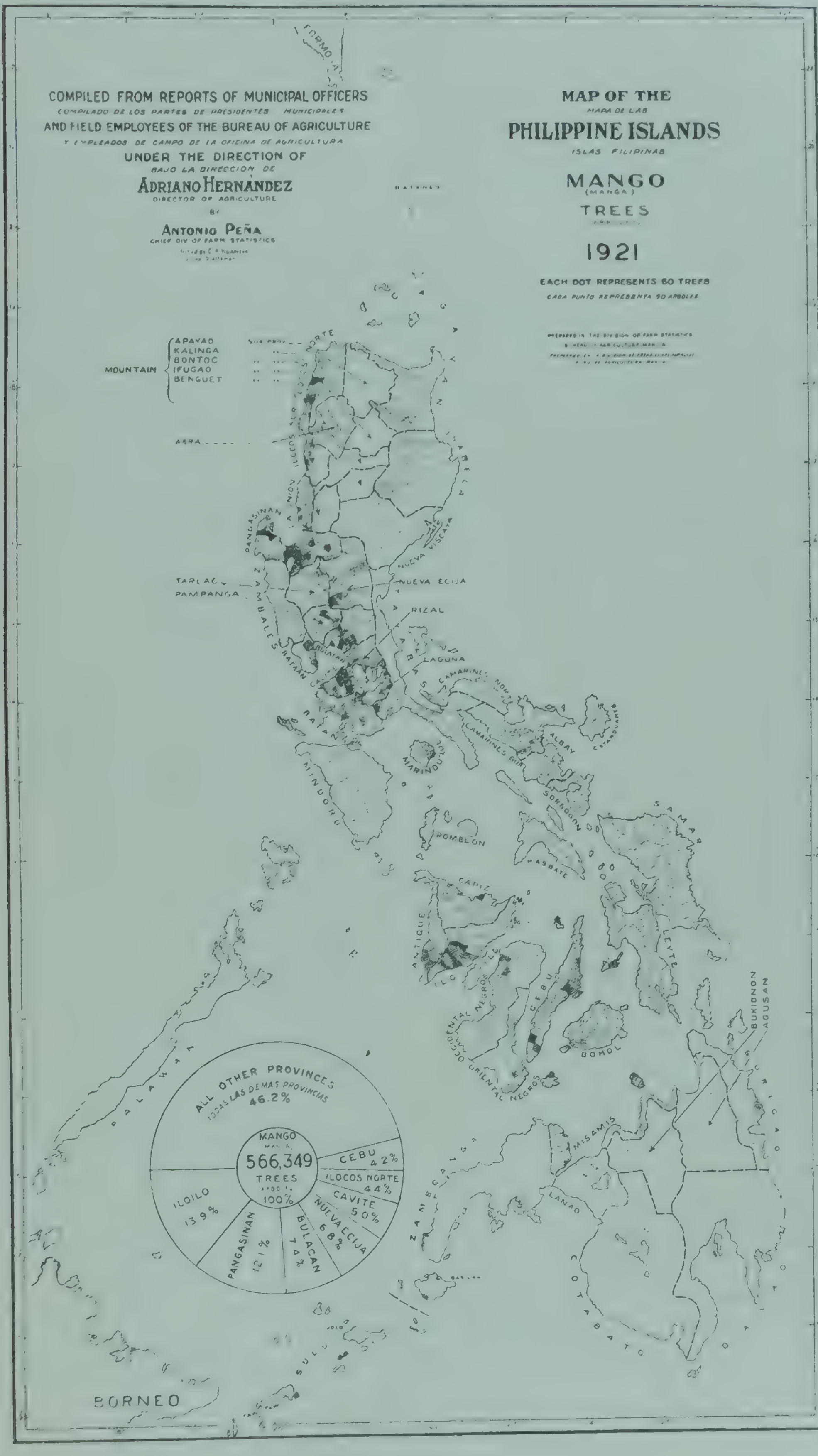
Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNANDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
BANANA
(PLATANO)
PLANTS
(PLANTAS)
1921
EACH DOT REPRESENTS 4,000 TREES
FORMOSA
BATANES
MOUNTAIN
APAYAO Sub-Prov
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
TARLAC
PAMPANGA
ZAMBALES
BATAAN
CAVITE
BATANGAS
CAGAYAN
ISABELA
NUEVA VIZCAYA
NUEVA ECIJA
RIZAL
LAGUNA
TAYABAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
SORSOGON
MARINDUQUE
MINDORO
MASBATE
ROMBLON
CAPIZ
ANTIQUE
ILOILO
OCCIDENTAL NEGROS
ORIENTAL NEGROS
CEBU
BOHOL
SAMAR
LEYTE
BUKIDNON
AGUSAN
SURIGAO
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
PALAWAN
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROV.AS
49.4%
TOTAL
55,470,870
PLANTS
(PLANTAS)
100%
CAGAYAN 4.5%
ILOCOS NORTE 4.6%
ILOILO 5.0%
SAMAR 5.2%
BATANGAS 5.5%
PANGASINAN 6.0%
LEYTE 6.9%
CEBU 12.9%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COMPILADO DE LOS PARTES DE PRESIDENTES MUNICIPALES
AND FIELD EMPLOYEES OF THE BUREAU OF AGRICULTURE
Y EMPLEADOS DE CAMPO DE LA OFICINA DE AGRICULTURA
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNANDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF DIV OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
MANGO
(MANGA)
TREES
1921
EACH DOT REPRESENTS 50 TREES
CADA PUNTO REPRESENTA 50 ARBOLES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
TARLAC
PAMPANGA
PANGASINAN
ZAMBALES
NUEVA VISCAYA
NUEVA ECIJA
RIZAL
LAGUNA
BULACAN
BATAAN
CAVITE
BATANGAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
CATANDUANES
SORSOGON
MARINDUQUE
MINDORO
ROMBLON
MASBATE
SAMAR
LEYTE
CAPIZ
ANTIQUE
ILOILO
OCCIDENTAL NEGROS
ORIENTAL NEGROS
CEBU
BOHOL
BUKIDNON
AGUSAN
SURIGAO
MISAMIS
LANAO
ZAMBOANGA
COTABATO
DAVAO
PALAWAN
SULU
BORNEO
FORMOSA
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
46.2%
MANGO
566,349
TREES
100%
CEBU 4.2%
ILOCOS NORTE 4.4%
CAVITE 5.0%
NUEVA ECIJA 6.8%
BULACAN 7.4%
PANGASINAN 12.1%
ILOILO 13.9%

TABLE XIII

Crops	Trees	Production	Value
		Kilos	
Castor beans	1,393,830	182,427	₱31,919
Lumbang	101,880	1,194,326	355,618
Kapok	1,068,204	423,807	316,086
Rubber	364,631	92,209	138,314

LIVESTOCK

The enumeration of animals is made on December 31 of each year and the statistics are prepared after the reception of the schedules filled out by the municipal presidents. At the time this is written there are available only the figures for the preceding year, those for December 31, 1920, and these are herein presented.

During the year 1920 there was registered a general increase in the number of all domestic animals, and some of them, as hogs, goats, and sheep, showed the highest rate of increase ever recorded since 1910, the first year for which the Bureau of Agriculture compiled statistics. These increases were as follows: Carabaos, 5 per cent; cattle, 12 per cent; horses and mules, 5 per cent; hogs, 16 per cent; goats, 12 per cent; and sheep, 17 per cent. It is well to state, however, that the Bureau of Agriculture received reports for this period from most of the municipal districts of the different provinces of Mindanao and Sulu that were not included in previous counts.

For three consecutive years the rate of births of all animals went on declining, a fact that was set forth in the last annual report. Fortunately this decline did not continue during the year 1920, as a general increase was registered, especially for cattle, horses, and sheep. Compared with the average rate for 1915–19, the rates during 1920 were the following: Carabaos, 13.9 per cent against 11.0 per cent; cattle, 25.5 per cent against 20.1 per cent; horses and mules, 20.2 per cent against 15.7 per cent; hogs, 30.2 per cent against 29.7 per cent; goats, 23.3 per cent against 22.6 per cent; sheep, 29.3 per cent against 24.3 per cent.

On the contrary, the rate of mortality for all animals except cattle, rose slightly—by fractions of 1 per cent—and that for hogs was the highest rate on record. This was due to the several typhoons and heavy rains during the year that occasioned floods, in which many hogs were drowned and because of which many others contracted diseases and died.

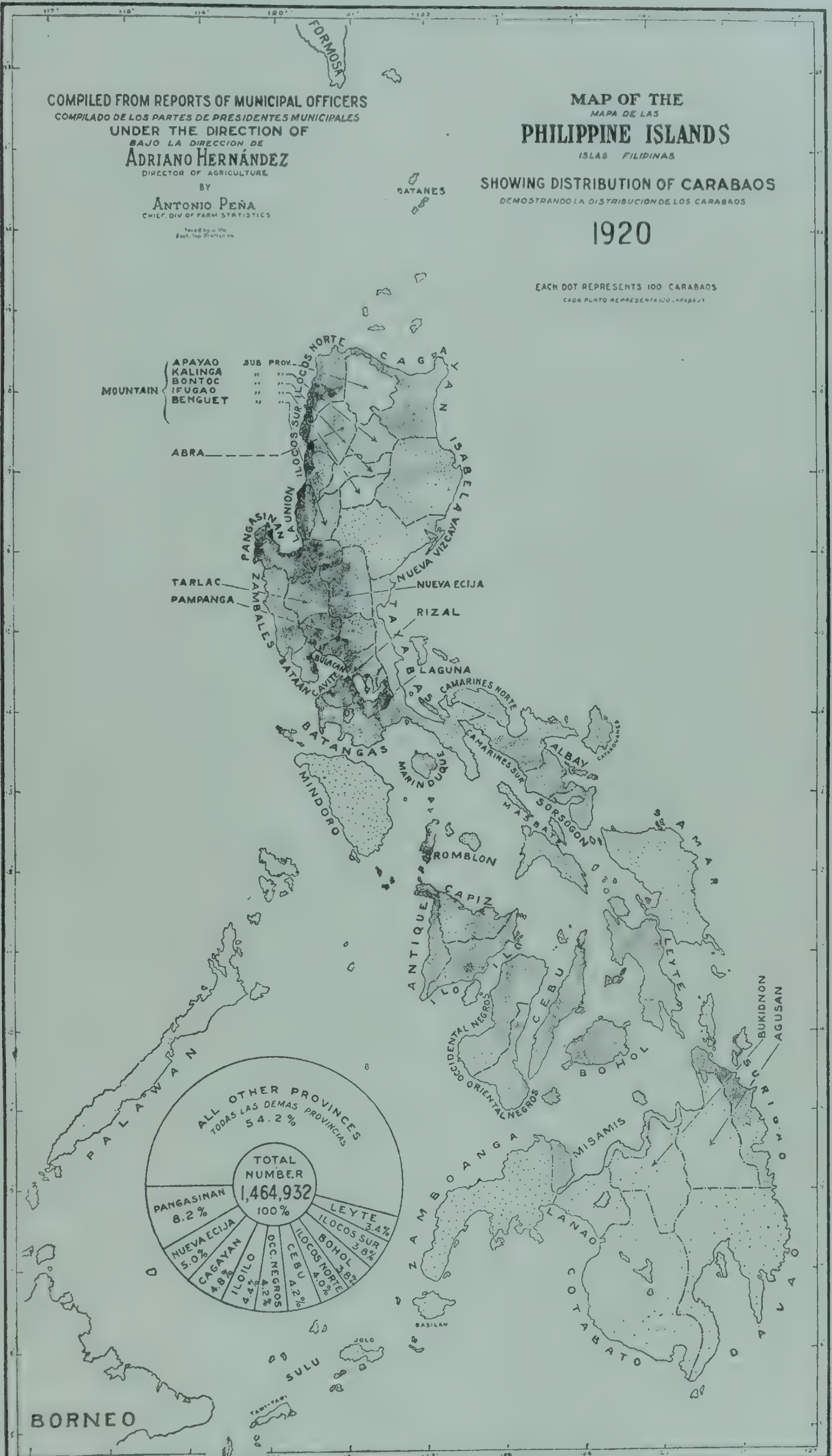
It is safe to state, however, that the epizoötic diseases registered in the Islands have not done the terrible amount of damage that is talked of so often, tending to popularize the idea that animal production is decreasing.

The following table gives the number of animals of each kind in the Islands during the last eleven years. By comparing the figures for the first and the last year it will be learned that despite the lack of intelligent care on the part of many owners and herdsmen, despite the annual losses from diseases, the livestock industry on these Islands is gradually progressing, at least, as regards numbers.

TABLE XIV

Year	Carabaos	Cattle	Horses
1910	705,758	243,180	138,199
1911	809,267	289,771	146,641
1912	911,318	337,202	162,383
1913	1,047,164	418,114	179,089
1914	1,147,433	477,736	215,826
1915	1,221,966	534,123	223,195
1916	1,228,836	567,456	203,364
1917	1,271,208	603,107	214,209
1918	1,338,082	601,297	234,041
1919	1,388,244	678,525	255,380
1920	1,464,285	760,920	268,999
Year	**Hogs**	**Goats**	**Sheep**
1910	1,637,338	422,185	88,805
1911	1,661,831	441,325	92,617
1912	1,735,047	476,638	97,640
1913	2,016,736	529,180	104,147
1914	2,285,880	592,042	118,010
1915	2,521,143	644,562	129,509
1916	2,734,803	661,859	142,091
1917	2,810,737	722,532	155,827
1918	2,894,403	741,077	165,686
1919	3,129,676	731,849	168,181
1920	3,639,183	821,661	195,705

NOTE.—The Bureau of Agriculture, Manila, P. I., will furnish agricultural statistics to interested parties applying for same.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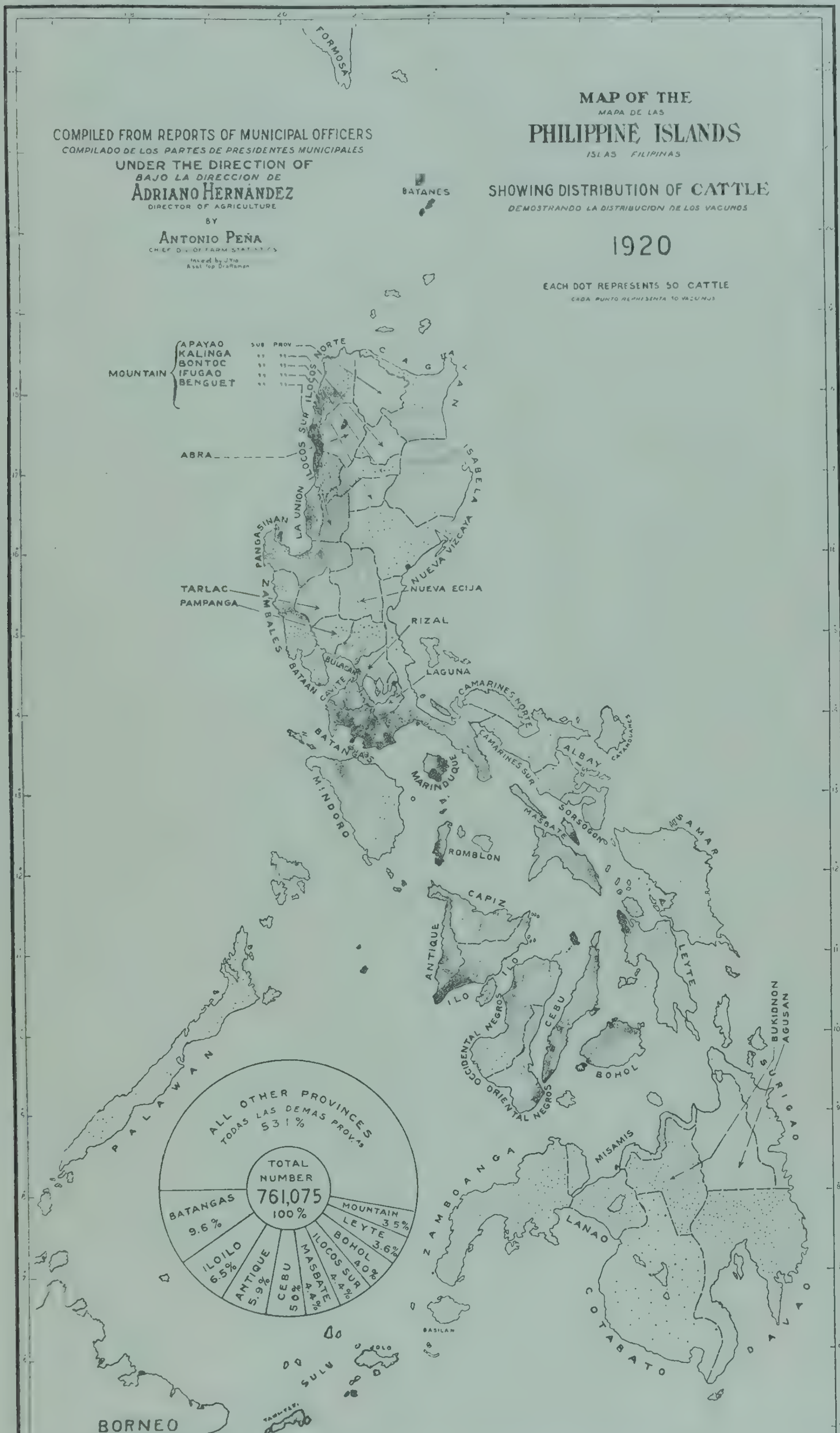
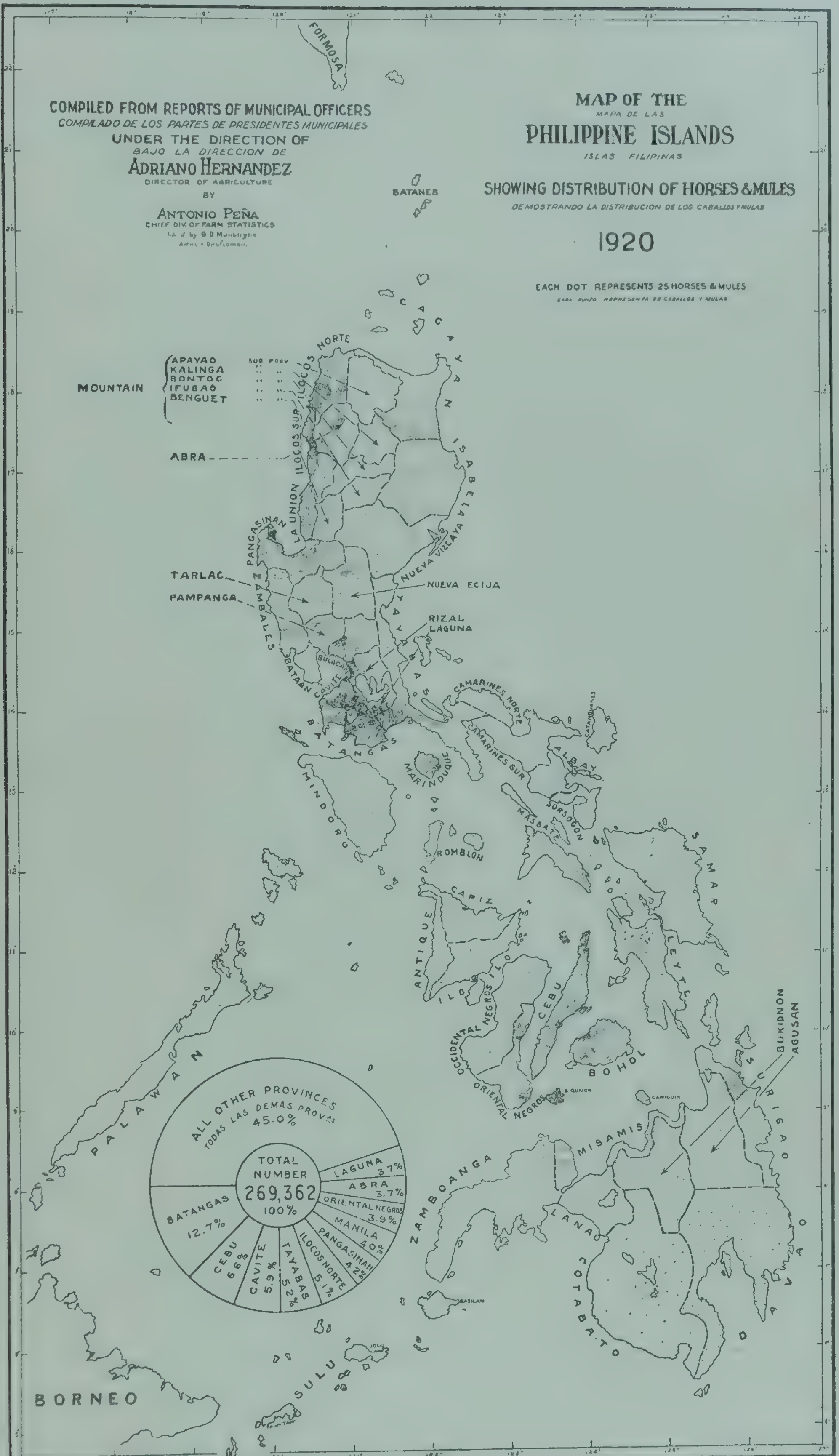
COMPILADO DE LOS PARTES DE PRESIDENTES MUNICIPALES
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNÁNDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF, DIV OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SHOWING DISTRIBUTION OF CARABAOS
DEMOSTRANDO LA DISTRIBUCION DE LOS CARABAOS
1920
EACH DOT REPRESENTS 100 CARABAOS
FORMOSA
BATANES
MOUNTAIN
APAYAO SUB PROV.
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
CAGAYAN
ISABELA
NUEVA VIZCAYA
NUEVA ECIJA
TARLAC
PAMPANGA
ZAMBALES
RIZAL
BULACAN
BATAAN
CAVITE
LAGUNA
TAYABAS
BATANGAS
MINDORO
MARINDUQUE
CAMARINES NORTE
CAMARINES SUR
ALBAY
CATANDUANES
SORSOGON
MASBATE
ROMBLON
CAPIZ
ANTIQUE
ILOILO
OCCIDENTAL NEGROS
ORIENTAL NEGROS
CEBU
BOHOL
SAMAR
LEYTE
SURIGAO
BUKIDNON
AGUSAN
MISAMIS
LANAO
ZAMBOANGA
COTABATO
DAVAO
PALAWAN
BASILAN
JOLO
SULU
TAWI-TAWI
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
54.2%
TOTAL NUMBER
1,464,932
100%
PANGASINAN 8.2%
NUEVA ECIJA 5.0%
CAGAYAN 4.8%
ILOILO 4.4%
OCC. NEGROS 4.2%
CEBU 4.2%
ILOCOS NORTE 4.0%
BOHOL 3.8%
ILOCOS SUR 3.8%
LEYTE 3.4%


MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SHOWING DISTRIBUTION OF CATTLE
DEMOSTRANDO LA DISTRIBUCION DE LOS VACUNOS
1920
EACH DOT REPRESENTS 50 CATTLE
COMPILED FROM REPORTS OF MUNICIPAL OFFICERS
COMPILADO DE LOS PARTES DE PRESIDENTES MUNICIPALES
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNANDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
FORMOSA
BATANES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
SUB PROV
ILOCOS NORTE
CAGAYAN
ABRA
ILOCOS SUR
ISABELA
LA UNION
PANGASINAN
NUEVA VIZCAYA
TARLAC
PAMPANGA
ZAMBALES
NUEVA ECIJA
RIZAL
BULACAN
BATAAN
CAVITE
LAGUNA
CAMARINES NORTE
CAMARINES SUR
BATANGAS
MARINDUQUE
ALBAY
CATANDUANES
MINDORO
SORSOGON
MASBATE
ROMBLON
SAMAR
CAPIZ
ANTIQUE
ILOILO
LEYTE
CEBU
OCCIDENTAL NEGROS
ORIENTAL NEGROS
BOHOL
BUKIDNON
AGUSAN
SURIGAO
PALAWAN
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
BASILAN
JOLO
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVAS
53.1%
TOTAL NUMBER
761,075
100%
BATANGAS 9.6%
ILOILO 6.5%
ANTIQUE 5.9%
CEBU 5.0%
MASBATE 4.4%
ILOCOS SUR 4.4%
BOHOL 4.0%
LEYTE 3.6%
MOUNTAIN 3.5%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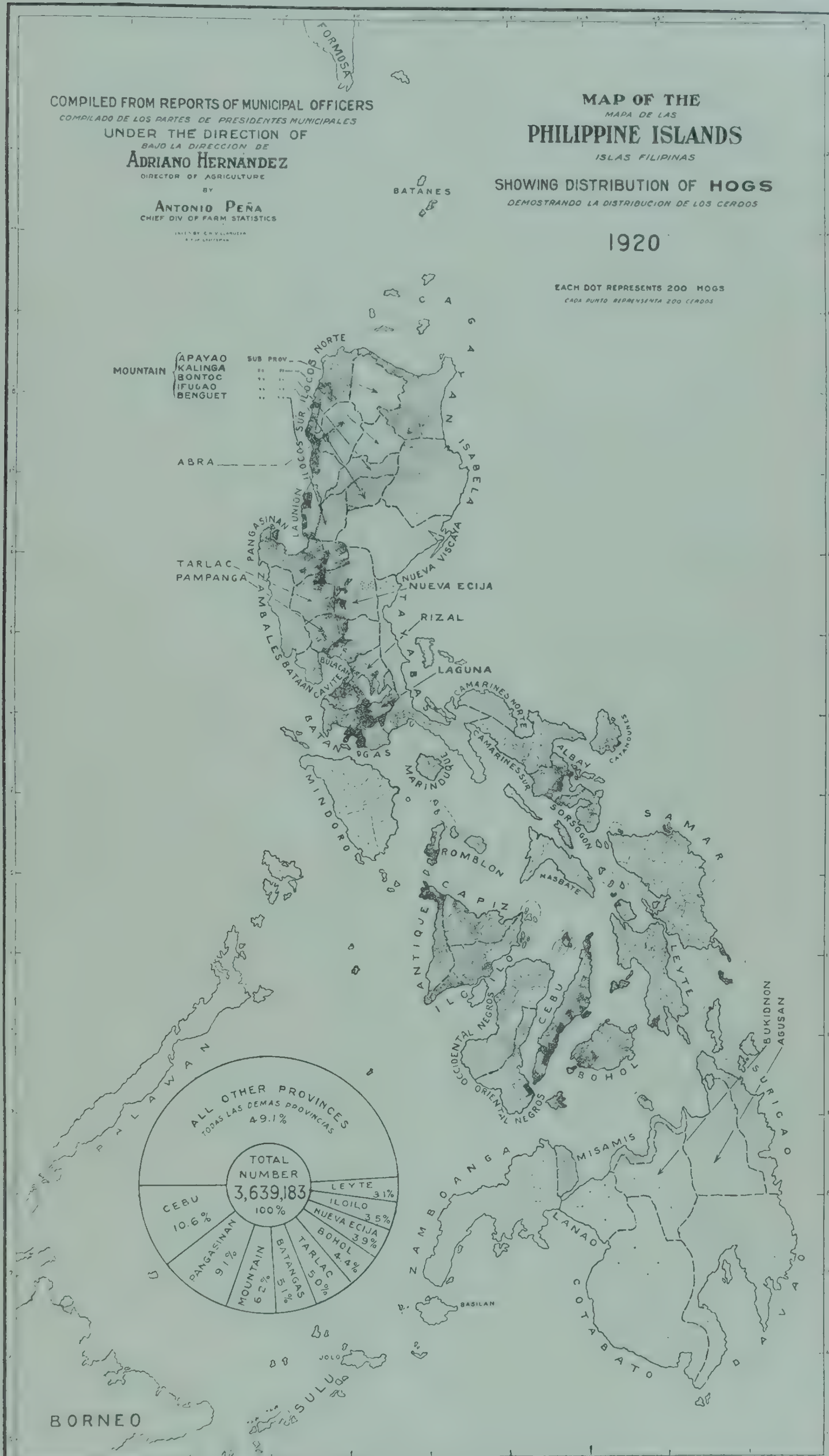
UNDER THE DIRECTION OF
BAJO LA DIRECCION DE
ADRIANO HERNANDEZ
DIRECTOR OF AGRICULTURE
BY
ANTONIO PEÑA
CHIEF DIV. OF FARM STATISTICS
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SHOWING DISTRIBUTION OF HORSES & MULES
DEMOSTRANDO LA DISTRIBUCION DE LOS CABALLOS Y MULAS
1920
EACH DOT REPRESENTS 25 HORSES & MULES
CADA PUNTO REPRESENTA 25 CABALLOS Y MULAS
FORMOSA
BATANES
CAGAYAN
ILOCOS NORTE
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
SUB PROV
ILOCOS SUR
ABRA
LA UNION
ISABELA
NUEVA VIZCAYA
PANGASINAN
TARLAC
PAMPANGA
ZAMBALES
NUEVA ECIJA
RIZAL
LAGUNA
TAYABAS
BULACAN
BATAAN
CAVITE
BATANGAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
SORSOGON
MARINDUQUE
MINDORO
MASBATE
ROMBLON
SAMAR
CAPIZ
ANTIQUE
ILOILO
LEYTE
OCCIDENTAL NEGROS
CEBU
BOHOL
ORIENTAL NEGROS
SIQUIJOR
CAMIGUIN
BUKIDNON
AGUSAN
SURIGAO
PALAWAN
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
BASILAN
JOLO
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVAS
45.0%
TOTAL NUMBER
269,362
100%
LAGUNA 3.7%
ABRA 3.7%
ORIENTAL NEGROS 3.9%
MANILA 4.0%
PANGASINAN 4.2%
ILOCOS NORTE 5.1%
TAYABAS 5.2%
CAVITE 5.9%
CEBU 6.6%
BATANGAS 12.7%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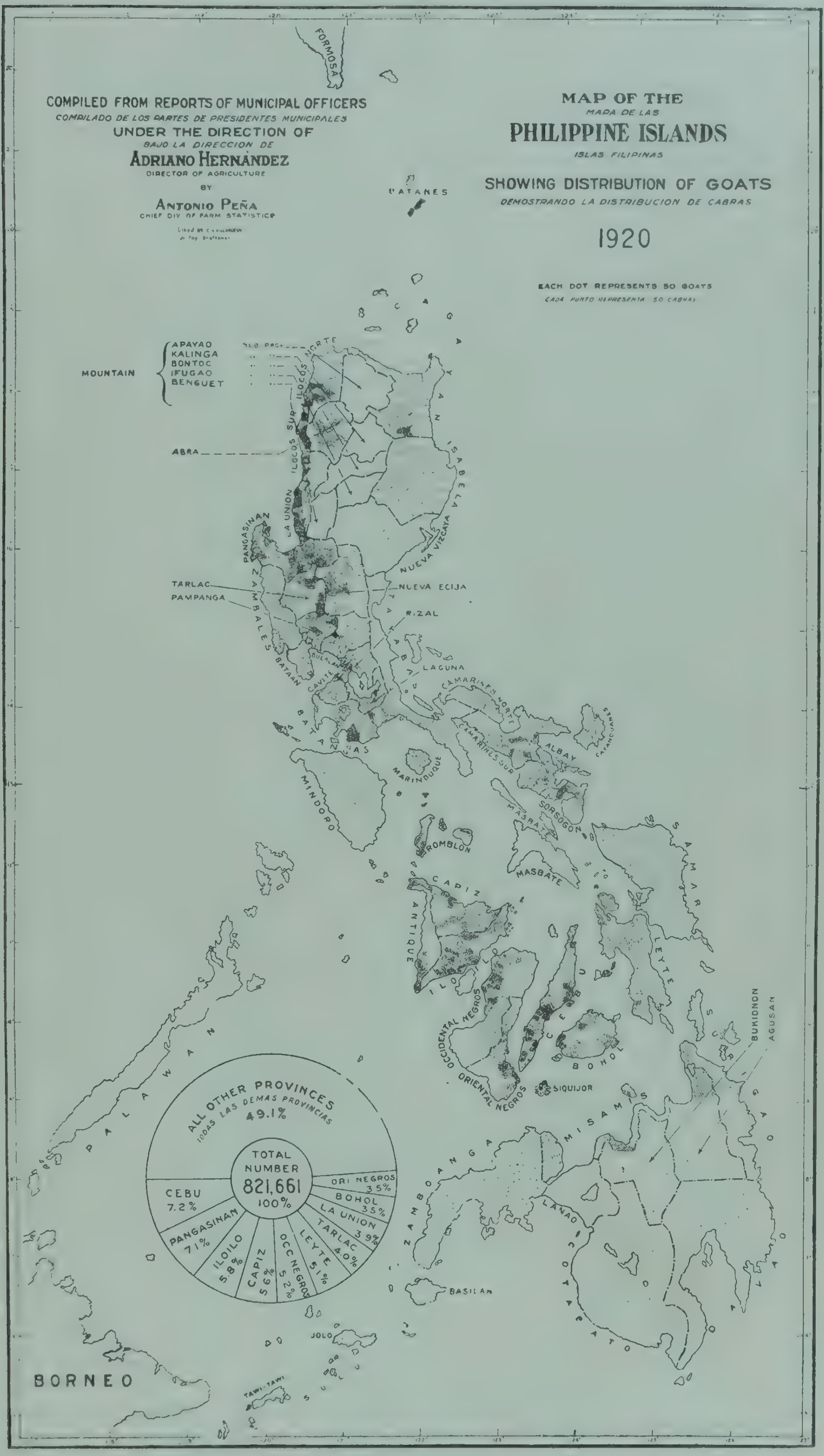
MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SHOWING DISTRIBUTION OF HOGS
DEMOSTRANDO LA DISTRIBUCION DE LOS CERDOS
1920
EACH DOT REPRESENTS 200 HOGS
CADA PUNTO REPRESENTA 200 CERDOS
FORMOSA
BATANES
CAGAYAN
ILOCOS NORTE
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
SUB PROV.
ILOCOS SUR
ABRA
ISABELA
LA UNION
PANGASINAN
NUEVA VISCAYA
TARLAC
PAMPANGA
NUEVA ECIJA
ZAMBALES
TAYABAS
RIZAL
BULACAN
BATAAN
CAVITE
LAGUNA
BATANGAS
CAMARINES NORTE
CAMARINES SUR
CATANDUANES
ALBAY
SORSOGON
MARINDUQUE
MINDORO
ROMBLON
MASBATE
SAMAR
CAPIZ
ANTIQUE
ILOILO
LEYTE
OCCIDENTAL NEGROS
ORIENTAL NEGROS
CEBU
BOHOL
BUKIDNON
AGUSAN
SURIGAO
PALAWAN
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
BASILAN
JOLO
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
49.1%
TOTAL NUMBER
3,639,183
100%
LEYTE 3.1%
ILOILO 3.5%
NUEVA ECIJA 3.9%
BOHOL 4.4%
TARLAC 5.0%
BATANGAS 5.1%
MOUNTAIN 6.2%
PANGASINAN 9.1%
CEBU 10.6%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MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SHOWING DISTRIBUTION OF GOATS
DEMOSTRANDO LA DISTRIBUCION DE CABRAS
1920
EACH DOT REPRESENTS 50 GOATS
(CADA PUNTO REPRESENTA 50 CABRAS)
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
49.1%
TOTAL NUMBER
821,661
100%
CEBU 7.2%
PANGASINAN 7.1%
ILOILO 5.8%
CAPIZ 5.6%
OCC NEGROS 5.2%
LEYTE 5.1%
TARLAC 4.0%
LA UNION 3.9%
BOHOL 3.5%
ORI NEGROS 3.5%
FORMOSA
BATANES
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
ABRA
ILOCOS NORTE
ILOCOS SUR
LA UNION
PANGASINAN
TARLAC
PAMPANGA
ZAMBALES
BATAAN
BULACAN
CAVITE
BATANGAS
NUEVA ECIJA
NUEVA VIZCAYA
ISABELA
CAGAYAN
RIZAL
LAGUNA
TAYABAS
CAMARINES NORTE
CAMARINES SUR
ALBAY
CATANDUANES
SORSOGON
MASBATE
MARINDUQUE
MINDORO
ROMBLON
CAPIZ
ANTIQUE
ILOILO
OCCIDENTAL NEGROS
ORIENTAL NEGROS
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BOHOL
SIQUIJOR
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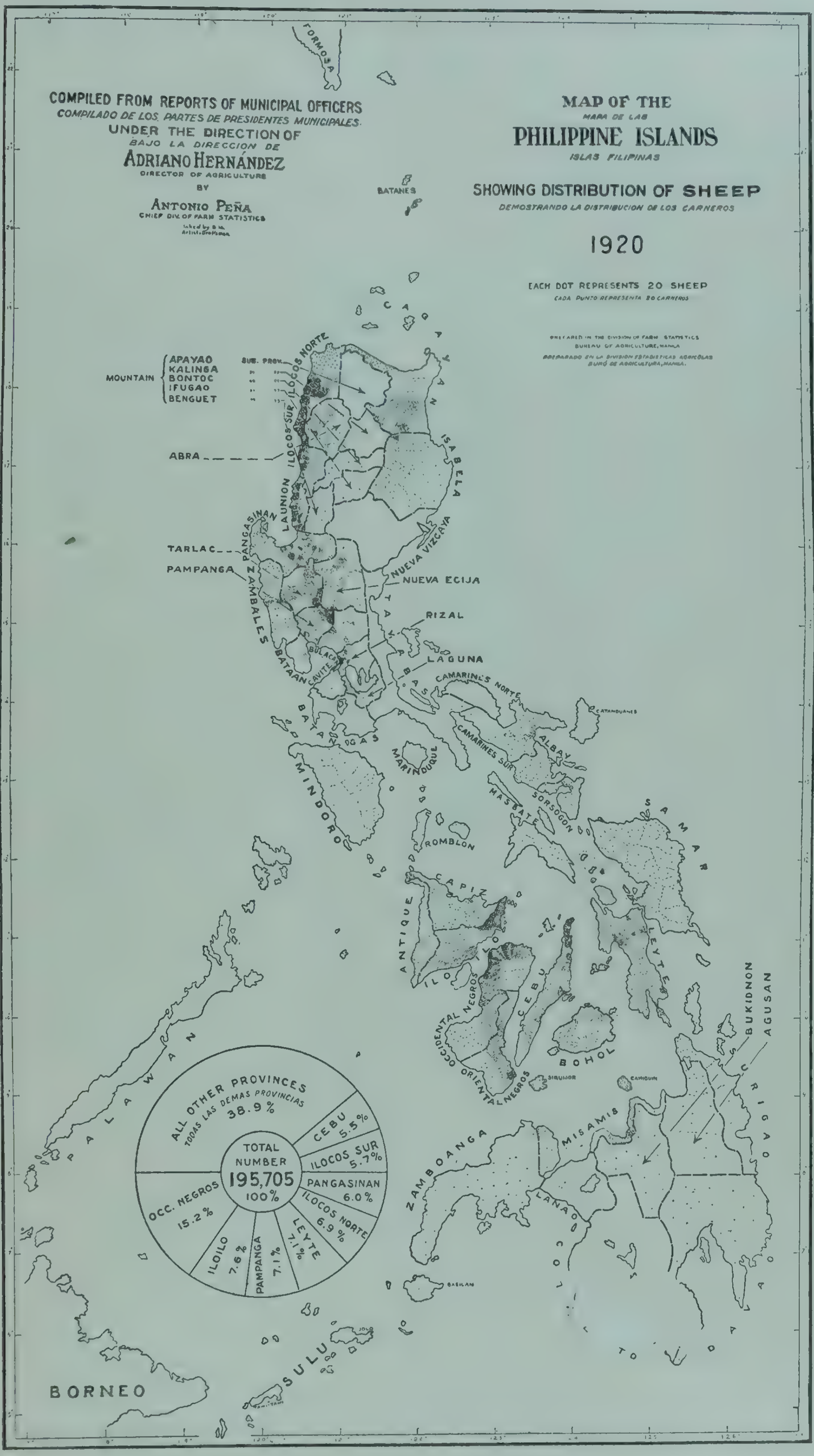
BASILAN
JOLO
TAWI-TAWI
SULU
PALAWAN
BORNEO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MAP OF THE
MAPA DE LAS
PHILIPPINE ISLANDS
ISLAS FILIPINAS
SHOWING DISTRIBUTION OF SHEEP
DEMOSTRANDO LA DISTRIBUCION DE LOS CARNEROS
1920
EACH DOT REPRESENTS 20 SHEEP
CADA PUNTO REPRESENTA 20 CARNEROS
FORMOSA
BATANES
CAGAYAN
ISABELA
MOUNTAIN
APAYAO
KALINGA
BONTOC
IFUGAO
BENGUET
SUB. PROV.
ILOCOS NORTE
ILOCOS SUR
ABRA
LA UNION
PANGASINAN
NUEVA VIZCAYA
TARLAC
PAMPANGA
ZAMBALES
NUEVA ECIJA
TAYABAS
RIZAL
LAGUNA
BULACAN
BATAAN
CAVITE
CAMARINES NORTE
CAMARINES SUR
ALBAY
BATANGAS
MARINDUQUE
MINDORO
MASBATE
SORSOGON
SAMAR
ROMBLON
CAPIZ
ANTIQUE
ILOILO
LEYTE
CEBU
OCCIDENTAL NEGROS
ORIENTAL NEGROS
BOHOL
BUKIDNON
AGUSAN
SURIGAO
PALAWAN
MISAMIS
ZAMBOANGA
LANAO
COTABATO
DAVAO
SULU
BORNEO
ALL OTHER PROVINCES
TODAS LAS DEMAS PROVINCIAS
38.9%
CEBU 5.5%
ILOCOS SUR 5.7%
PANGASINAN 6.0%
ILOCOS NORTE 6.9%
LEYTE 7.1%
PAMPANGA 7.1%
ILOILO 7.6%
OCC. NEGROS 15.2%
TOTAL NUMBER
195,705
100%

Rough rice statistics for the Philippine Islands for the year ending June 30, 1921

Rank	Province	Area cultivated	Production	Average production per hectare	Average price per liter in municipal markets	Total value of rough rice in municipal markets
		Hectares	*Liters*	*Liters*		
30	Abra	13,556	16,654,725	1,229	₱0.091	₱1,522,228
42	Agusan	7,290	7,928,700	1,088	.049	384,952
10	Albay	42,339	79,356,750	1,874	.051	4,060,771
24	Antique	30,486	37,371,375	1,226	.062	2,303,865
26	Bataan	12,668	28,875,600	2,279	.055	1,600,729
48	Batanes	57	61,875	1,086	.107	6,600
15	Batangas	50,945	55,111,575	1,082	.067	3,694,593
23	Bohol	38,467	39,709,800	1,032	.073	2,918,217
47	Bukidnon	2,113	1,389,450	658	.073	101,554
6	Bulacan	62,195	128,344,125	2,064	.047	6,015,567
19	Cagayan	28,923	44,830,800	1,550	.075	3,352,053
39	Camarines Norte	5,970	9,905,550	1,659	.042	412,184
11	Camarines Sur	46,057	72,350,025	1,571	.042	3,067,621
8	Capiz	45,638	86,372,250	1,893	.052	4,511,316
16	Cavite	40,446	54,495,825	1,347	.053	2,899,221
36	Cebu	11,166	12,638,100	1,132	.072	908,297
29	Cotabato	18,473	19,602,525	1,061	.054	1,067,670
41	Davao	7,837	8,929,650	1,139	.084	747,471
9	Ilocos Norte	64,859	81,161,550	1,251	.072	5,828,521
12	Ilocos Sur	46,142	63,297,075	1,372	.083	5,268,438
4	Iloilo	137,238	172,759,875	1,259	.070	12,049,535
44	Isabela	3,015	4,751,625	1,576	.130	617,182
14	Laguna	29,081	58,555,425	2,014	.047	2,752,713
31	Lanao	15,655	16,406,400	1,048	.056	924,882
7	La Union	54,958	102,478,500	1,865	.075	7,704,307
13	Leyte	34,625	60,247,275	1,740	.066	3,989,852
34	Marinduque	11,576	15,524,475	1,341	.041	631,303
45	Masbate	3,250	2,851,575	877	.065	184,681
38	Mindoro	8,566	11,451,075	1,337	.056	641,788
28	Misamis	9,807	20,542,875	2,095	.064	1,306,300
20	Mountain	42,235	44,622,975	1,057	.068	3,031,952
1	Nueva Ecija	184,916	586,356,600	3,171	.034	19,736,948
35	Nueva Vizcaya	6,811	15,482,925	2,273	.072	1,114,214
17	Occidental Negros	45,293	54,181,725	1,196	.069	3,721,609
37	Oriental Negros	6,005	12,418,725	2,068	.069	860,605
43	Palawan	4,865	4,862,175	999	.077	373,206
5	Pampanga	76,099	136,397,775	1,792	.041	5,572,764
2	Pangasinan	183,848	497,114,775	2,704	.044	22,069,781
21	Rizal	18,741	41,116,500	2,194	.047	1,936,262
40	Romblon	7,449	9,357,075	1,256	.060	560,079
27	Samar	18,663	23,920,275	1,282	.057	1,362,412
33	Sorsogon	17,078	15,575,850	912	.055	857,420
46	Sulu	2,180	2,351,250	1,079	.069	161,625
25	Surigao	19,246	29,560,575	1,536	.039	1,148,924
3	Tarlac	91,590	222,401,400	2,428	.030	6,664,380
22	Tayabas	29,406	40,600,800	1,381	.083	3,365,614
18	Zambales	26,458	44,915,100	1,698	.045	2,033,469
32	Zamboanga	9,100	15,697,575	1,725	.054	847,005
	Philippine Islands	1,673,381	3,110,890,500	1,859	.050	156,892,680

Sugar cane statistics for the year ending June 30, 1921

Rank	Province	Area Cultivated	Products derived from sugar cane			
			Sugar		Panocha	
			Kilos	Piculs	Kilos	Piculs
		Hectares				
29	Abra	333	9,171	145	357,869	5,658
43	Agusan	243	5,060	80	...	...
31	Albay	741	...	...	315,554	4,989
13	Antique	3,922	8,206,498	129,747	...	...
17	Bataan	2,631	3,311,896	52,362	...	...
44	Batanes	46	...	...	1,328	21
2	Batangas	28,840	61,466,224	971,798	11,258	178
23	Bohol	998	513,906	8,125	798,595	12,626
42	Bukidnon	94	...	...	8,792	139
16	Bulacan	4,216	3,878,427	61,319	...	...
37	Cagayan	253	2,087	33	59,012	933
36	Camarines Norte	239	...	...	66,476	1,051
22	Camarines Sur	1,975	...	...	1,656,960	26,197
10	Capiz	2,523	8,479,738	134,067	1,300,546	20,562
12	Cavite	3,333	8,153,178	128,904	719,153	11,370
11	Cebu	7,237	8,736,596	138,128	426,558	6,744
35	Cotabato	106	82,541	1,305	1,139	18
....	Davao	...	...	...	...	...
24	Ilocos Norte	2,779	...	...	727,628	11,504
5	Ilocos Sur	8,818	19,143,182	302,659	1,256,208	19,861
4	Iloilo	13,533	23,352,343	369,207	...	...
45	Isabela	124	...	...	316	5
8	Laguna	7,191	12,174,487	192,482	1,038,565	16,420
30	Lanao	328	271,975	4,300	85,957	1,359
15	La Union	2,731	2,207,109	34,895	2,742,900	43,366
20	Leyte	1,752	1,007,256	15,925	1,257,663	19,884
39	Marinduque	55	...	...	34,155	540
40	Masbate	31	...	...	30,992	490
14	Mindoro	1,996	6,704,500	106,000	53,763	850
34	Misamis	57	101,453	1,604	2,024	32
26	Mountain	676	449,897	7,113	39,405	623
21	Nueva Ecija	924	306,383	4,844	1,912,870	30,243
38	Nueva Vizcaya	114	...	...	57,810	914
1	Occidental Negros	82,635	242,384,752	3,832,170	...	...
6	Oriental Negros	3,200	19,431,159	307,212	759	12
41	Palawan	15	...	...	23,339	369
3	Pampanga	36,500	58,282,345	921,460	149,143	2,358
9	Pangasinan	4,781	7,784,873	123,081	2,507,104	39,638
19	Rizal	1,940	1,721,728	27,221	592,652	9,370
....	Romblon	...	...	...	...	...
25	Samar	910	66,413	1,050	573,045	9,060
18	Sorsogon	2,186	...	...	2,508,179	39,655
....	Sulu	...	...	...	...	...
27	Surigao	364	...	...	486,519	7,692
7	Tarlac	8,534	11,866,902	187,619	2,152,208	34,027
28	Tayabas	940	...	...	446,861	7,065
33	Zambales	346	2,973	47	110,877	1,753
32	Zamboanga	155	66,286	1,048	48,323	764
	Philippine Islands	241,345	510,171,338	8,065,950	24,562,505	388,340

Sugar cane statistics for the year ending June 30, 1921—Continued

Province	Products derived from sugar cane	
	Basi	Molasses
	Liters	*Liters*
Abra	777,323	10,869
Agusan	2,695	494,450
Albay	127,400	396,549
Antique		
Bataan		45,500
Batanes	161,588	
Batangas		2,003,750
Bohol		
Bukidnon	422	1,169
Bulacan		93,693
Cagayan	438,922	16,047
Camarines Norte	120	4,360
Camarines Sur	16,520	25,142
Capiz		
Cavite		
Cebu		
Cotabato		
Davao		
Ilocos Norte	3,243,331	864,921
Ilocos Sur	1,528,548	101,740
Iloilo		660
Isabela	126,420	34,100
Laguna		10,908
Lanao		
La Union	505,080	32,500
Leyte		1,600
Marinduque		
Masbate	3,000	2,075
Mindoro		1,238,177
Misamis		
Mountain	376,965	36,710
Nueva Ecija	50,025	9,016
Nueva Vizcaya	93,407	67,081
Occidental Negros		335,764
Oriental Negros		
Palawan		
Pampanga		241,467
Pangasinan	322,930	929,967
Rizal		423,650
Romblon		
Samar	205	109
Sorsogon	280	866
Sulu		
Surigao	500	480
Tarlac	213,350	46,046
Tayabas	2,600	6,690
Zambales	44,960	48,689
Zamboanga		
Philippine Islands	8,039,591	7,524,745

Sugar cane statistics for the year ending June 30, 1921—Continued

Province	Average price in the municipal markets					
	Sugar per—		Panocha per—		Basi	Molasses
	Kilo	Picul	Kilo	Picul		
					Liter	*Liter*
Abra	₱0.22	₱13.74	₱0.20	₱12.62	₱0.12	₱0.27
Agusan	.25	15.50			.20	.15
Albay			.22	13.99	.17	.21
Antique	.13	8.13				
Bataan	.14	8.82				.04
Batanes			.19	11.90	.11	
Batangas	.09	5.80	.32	20.24		.05
Bohol	.10	6.49	.20	12.50		
Bukidnon			.27	17.12	.22	.20
Bulacan	.17	10.77				.06
Cagayan	.17	11.03	.18	11.47	.29	.47
Camarines Norte			.14	8.74	.10	.23
Camarines Sur			.17	10.90	.20	.28
Capiz	.16	9.91	.35	22.30		
Cavite	.17	10.98	.17	10.58		
Cebu	.13	8.13	.19	12.28		
Cotabato	.34	21.61	.11	6.72		
Davao						
Ilocos Norte			.21	13.35	.25	.31
Ilocos Sur	.07	4.32	.14	8.57	.15	.17
Iloilo	.14	9.15				.30
Isabela			.19	12.00	.27	.21
Laguna	.36	22.79	.28	17.97		.13
Lanao	.30	18.91	.17	10.57		
La Union	.10	6.34	.14	9.09	.25	.30
Leyte	.18	11.44	.16	10.40		.20
Marinduque			.24	14.90		
Masbate			.12	7.31	.05	.07
Mindoro	.30	18.96	.36	23.06		.10
Misamis	.26	16.18	.32	20.00		
Mountain	.16	9.97	.17	10.99	.20	.32
Nueva Ecija	.19	12.21	.18	11.28	.18	.31
Nueva Vizcaya			.24	15.35	.20	.34
Occidental Negros	.21	13.49				.30
Oriental Negros	.18	11.47	.18	11.67		
Palawan			.17	10.85		
Pampanga	.10	6.36	.08	4.91		.15
Pangasinan	.35	22.25	.25	16.09	.19	.22
Rizal	.11	6.87	.20	12.45		.20
Romblon						
Samar	.33	21.00	.16	9.99	.05	.10
Sorsogon			.14	8.91	.07	.22
Sulu						
Surigao			.28	17.75	.10	.30
Tarlac	.11	7.10	.13	7.99	.17	.35
Tayabas			.17	10.91	.07	.23
Zambales	.16	10.21	.22	14.04	.34	.26
Zamboanga	.20	12.50	.43	27.47		
Philippine Islands	.17	11.01	.19	11.96	.21	.16

Sugar cane statistics for the year ending June 30, 1921—Continued

Province	Value of sugar cane products in the municipal markets				Total value
	Sugar	Panocha	Basi	Molasses	
Abra	₱1,993	₱71,404	₱90,520	₱2,892	₱166,809
Agusan	1,240	....	539	71,820	73,599
Albay	....	69,800	21,841	82,120	173,761
Antique	1,055,830	....	....	....	1,055,830
Bataan	461,648	....	....	1,820	463,468
Batanes	....	250	18,901	....	19,151
Batangas	5,637,866	3,603	....	102,688	5,744,157
Bohol	52,768	157,804	....	....	210,572
Bukidnon	....	2,380	93	234	2,707
Bulacan	660,248	....	....	5,464	665,712
Cagayan	364	10,697	127,823	7,544	146,428
Camarines Norte	....	9,185	12	992	10,189
Camarines Sur	....	285,504	3,314	6,938	295,756
Capiz	1,328,471	458,597	....	....	1,787,068
Cavite	1,415,882	120,300	....	....	1,536,182
Cebu	1,122,492	82,846	....	....	1,205,338
Cotabato	28,200	121	....	....	28,321
Davao	....	....	....	....	....
Ilocos Norte	....	153,531	824,570	265,456	1,243,557
Ilocos Sur	1,307,332	170,248	222,997	16,826	1,717,403
Iloilo	3,377,029	....	....	201	3,377,230
Isabela	....	60	33,538	7,085	40,683
Laguna	4,386,882	295,148	....	1,423	4,683,453
Lanao	81,337	14,368	....	....	95,705
La Union	221,154	394,007	128,312	9,600	753,073
Leyte	182,191	206,770	....	320	389,281
Marinduque	....	8,048	....	....	8,048
Masbate	....	3,580	150	138	3,868
Mindoro	2,010,000	19,600	....	128,753	2,158,353
Misamis	25,955	640	....	....	26,595
Mountain	70,929	6,846	73,869	11,701	163,345
Nueva Ecija	59,140	341,021	9,198	2,816	412,175
Nueva Vizcaya	....	14,028	18,397	23,007	55,432
Occidental Negros	51,679,329	....	....	100,429	51,779,758
Oriental Negros	3,524,086	140	....	....	3,524,226
Palawan	....	4,005	....	....	4,005
Pampanga	5,858,381	11,580	....	35,882	5,905,843
Pangasinan	2,738,834	637,720	60,853	202,212	3,639,619
Rizal	186,914	116,670	....	83,425	387,009
Romblon	....	....	....	....	....
Samar	22,050	90,478	10	11	112,549
Sorsogon	....	353,467	19	188	353,674
Sulu	....	....	....	....	....
Surigao	....	136,564	50	144	136,758
Tarlac	1,333,002	271,919	35,420	15,897	1,656,238
Tayabas	....	77,103	180	1,552	78,835
Zambales	480	24,615	15,341	12,688	53,124
Zamboanga	13,105	20,988	....	....	34,093
Philippine Islands	88,845,132	4,645,635	1,685,947	1,202,266	96,378,980

Coconut statistics for the year ending June 30, 1921

Rank	Province	Trees planted	Trees bearing	Nuts gathered	Nuts consumed for food
		Number	*Number*	*Number*	
46	Abra	8,762	2,353	37,542	18,893
23	Agusan	523,337	206,432	9,314,521	594,136
9	Albay	4,323,439	2,445,606	38,602,827	14,103,954
27	Antique	715,525	436,885	3,164,677	256,888
39	Bataan	37,014	12,260	190,317	150,317
44	Batanes	24,012	15,620	54,422	34,250
25	Batangas	1,147,486	237,013	5,793,704	2,498,528
8	Bohol	2,437,682	1,459,682	45,954,005	804,947
43	Bukidnon	19,793	10,200	72,200	71,300
41	Bulacan	22,004	2,717	140,135	140,101
28	Cagayan	245,640	92,051	2,938,588	1,858,595
13	Camarines Norte	1,564,343	945,876	21,012,115	565,320
15	Camarines Sur	2,809,326	1,745,288	19,912,945	2,960,682
17	Capiz	2,195,839	1,077,594	18,189,739	960,126
31	Cavite	244,715	85,310	1,685,570	1,291,610
4	Cebu	6,141,178	3,155,872	141,942,951	6,553,337
32	Cotabato	524,241	69,596	1,441,538	638,348
26	Davao	813,271	198,635	3,469,325	68,656
36	Ilocos Norte	55,276	19,282	439,337	320,208
33	Ilocos Sur	117,666	76,800	1,239,857	268,411
18	Iloilo	1,587,373	606,260	14,672,541	2,619,991
38	Isabela	9,952	4,858	254,000	116,000
2	Laguna	8,714,396	6,382,179	265,792,915	3,049,554
35	Lanao	229,967	38,630	897,125	231,155
30	La Union	200,443	107,485	1,982,239	717,826
6	Leyte	3,172,822	1,897,311	94,410,940	7,738,021
16	Marinduque	2,021,115	1,172,190	19,551,521	2,251,470
22	Masbate	1,063,985	711,500	9,384,367	1,335,400
21	Mindoro	1,231,738	382,912	9,707,432	2,521,959
3	Misamis	4,855,519	3,242,960	169,517,723	2,503,037
42	Mountain	18,161	13,618	87,295	71,911
40	Nueva Ecija	41,057	15,460	140,950	64,075
47	Nueva Vizcaya	3,813	1,757	7,217	2,616
14	Occidental Negros	1,241,855	745,449	20,930,076	4,898,998
11	Oriental Negros	2,109,626	1,137,170	33,534,018	1,106,580
24	Palawan	510,081	206,028	7,806,871	794,873
45	Pampanga	10,335	2,185	42,575	42,575
12	Pangasinan	1,999,645	1,041,099	21,325,114	3,019,423
48	Rizal	12,128	338	2,117	2,117
20	Romblon	1,790,800	666,350	10,132,568	295,491
5	Samar	4,721,260	2,843,520	135,334,692	7,770,242
19	Sorsogon	1,267,300	740,742	14,560,296	3,664,811
34	Sulu	278,524	151,000	1,214,000	313,500
10	Surigao	1,249,317	828,687	33,683,119	303,698
37	Tarlac	59,295	25,603	297,144	222,108
1	Tayabas	17,986,984	9,171,871	296,554,577	689,615
29	Zambales	306,059	159,326	2,368,730	1,591,603
7	Zamboanga	2,927,797	1,867,621	67,794,655	1,458,864
	Philippine Islands	83,591,896	46,459,181	1,547,583,132	83,556,120

Coconut statistics for the year ending June 30, 1921—Continued

Province	Production of coconut products		
	Copra	Oil	Tuba
	Kilos	*Liters*	*Liters*
Abra	...	4,890	...
Agusan	2,167,767	2,571	108,555
Albay	6,557,127	296,039	3,266,012
Antique	586,517	84,440	2,472,650
Bataan	3,163	4,742	...
Batanes	...	2,252	...
Batangas	809,347	1,835	...
Bohol	11,233,706	72,259	4,260,649
Bukidnon	...	180	75
Bulacan	...	5	...
Cagayan	...	111,227	...
Camarines Norte	5,299,838	71,867	81,000
Camarines Sur	3,738,075	113,681	2,449,520
Capiz	4,387,842	87,612	5,349,469
Cavite	81,023	1,976	...
Cebu	30,983,076	162,265	31,132,179
Cotabato	126,816	15,943	31,683
Davao	899,478	2,036	211,003
Ilocos Norte	...	11,416	...
Ilocos Sur	81,656	44,437	...
Iloilo	2,654,413	10,008	19,175,589
Isabela	...	13,800	...
Laguna	71,427,276	575,767	1,067,542
Lanao	159,074	1,706	109,650
La Union	304,233	24,751	...
Leyte	22,249,073	148,618	8,677,285
Marinduque	6,674,836	768	1,431,410
Masbate	2,041,836	19,561	665,920
Mindoro	1,540,707	24,546	1,136,475
Misamis	41,728,112	17,661	4,257,037
Mountain	...	1,980	...
Nueva Ecija	...	11,566	...
Nueva Vizcaya	...	821	...
Occidental Negros	3,859,831	1,314	6,055,645
Oriental Negros	7,521,880	32,191	5,463,453
Palawan	1,257,600	65,062	357,638
Pampanga	...	...	...
Pangasinan	4,453,180	292,912	...
Rizal	...	...	...
Romblon	2,471,114	2,012	932,710
Samar	34,756,508	141,833	2,880,449
Sorsogon	2,371,938	187,754	48,568
Sulu	231,305	5,500	13,816
Surigao	8,438,942	6,118	1,336,130
Tarlac	...	7,290	...
Tayabas	72,871,906	30,270	533,160
Zambales	166,284	7,030	2,175
Zamboanga	20,487,497	34,211	347,289
Philippine Islands	374,622,476	2,706,723	103,854,736

Coconut statistics for the year ending June 30, 1921—Continued

Province	Average price per unit in the municipal markets			
	Nut, per 100	Copra, per 100 kilos	Oil, per liter	Tuba, per liter
Abra	₱16.32	....	₱.78	....
Agusan	4.12	₱11.97	.73	₱0.07
Albay	4.50	16.62	.40	.06
Antique	5.90	13.91	1.01	.15
Bataan	14.93	15.81	.35	....
Batanes	3.73	....	.49	....
Batangas	4.01	14.81	.35	....
Bohol	4.72	15.19	.41	.08
Bukidnon	7.19	....	.26	.09
Bulacan	19.99	....	.80	....
Cagayan	6.86	....	.91	....
Camarines Norte	3.91	16.20	.30	.10
Camarines Sur	4.43	14.33	.33	.05
Capiz	7.98	13.37	.86	.08
Cavite	3.81	12.39	.26	....
Cebu	7.67	16.28	.38	.15
Cotabato	11.27	15.80	.82	.05
Davao	7.99	12.84	1.78	.10
Ilocos Norte	12.87	....	1.06	....
Ilocos Sur	7.02	28.76	1.48	....
Iloilo	6.53	18.33	.97	.11
Isabela	4.06	....	.64	....
Laguna	3.54	20.03	.35	.02
Lanao	7.46	15.92	.24	.05
La Union	5.98	15.73	.66	....
Leyte	3.41	14.20	.23	.08
Marinduque	2.92	13.30	.67	.06
Masbate	2.90	13.34	.41	.19
Mindoro	2.86	15.40	.37	.06
Misamis	4.92	13.77	.34	.10
Mountain	7.28	....	.77	....
Nueva Ecija	14.33	....	.75	....
Nueva Vizcaya	15.02	....	1.14	....
Occidental Negros	4.30	17.60	.68	.08
Oriental Negros	2.35	13.16	.21	.07
Palawan	4.29	15.83	.49	.06
Pampanga	12.89	....	....	....
Pangasinan	5.42	15.97	.63	....
Rizal	10.01	....	....	....
Romblon	3.38	17.17	.66	.08
Samar	3.62	13.54	.53	.15
Sorsogon	3.87	13.04	.92	.12
Sulu	6.22	14.79	.35	.25
Surigao	4.58	13.66	.34	.09
Tarlac	11.16	....	.88	....
Tayabas	4.99	15.54	.48	.24
Zambales	5.52	14.93	.55	.25
Zamboanga	3.84	15.92	.79	.18
Philippine Islands	4.73	15.87	.53	.11

Coconut statistics for the year ending June 30, 1921—Continued

Province	Value of coconut products				Total value
	Food	Copra	Oil	Tuba	
Abra	₱3,084	....	₱3,818	....	₱6,902
Agusan	24,508	₱259,424	1,864	₱7,445	293,241
Albay	634,057	1,089,637	118,861	198,212	2,040,767
Antique	15,152	81,598	84,892	372,904	554,546
Bataan	22,444	500	1,644	....	24,588
Batanes	1,276	....	1,102	....	2,378
Batangas	100,295	119,899	643	....	220,837
Bohol	38,032	1,706,680	29,836	358,362	2,132,910
Bukidnon	5,125	....	46	7	5,178
Bulacan	28,000	....	4	....	28,004
Cagayan	127,452	....	100,821	....	228,273
Camarines Norte	22,086	858,292	21,372	8,100	909,850
Camarines Sur	131,206	535,663	37,022	123,464	827,355
Capiz	76,651	586,618	32,313	448,690	1,144,272
Cavite	49,217	10,036	507	....	59,760
Cebu	502,568	5,043,199	61,171	4,641,906	10,248,844
Cotabato	71,961	20,040	13,142	1,643	106,786
Davao	5,488	115,486	3,633	21,100	145,707
Ilocos Norte	41,227	....	12,125	....	53,352
Ilocos Sur	18,849	23,481	65,884	....	108,214
Iloilo	170,974	486,678	9,693	2,023,393	2,690,738
Isabela	4,710	....	8,800	....	13,510
Laguna	108,048	14,312,665	203,201	25,755	14,649,669
Lanao	17,248	25,318	406	5,580	48,552
La Union	42,901	47,845	16,408	....	107,154
Leyte	264,061	3,159,009	33,640	711,004	4,167,714
Marinduque	65,739	887,759	517	92,329	1,046,344
Masbate	38,692	272,436	8,020	126,555	445,703
Mindoro	72,078	237,227	9,153	67,551	386,009
Misamis	123,051	5,746,548	6,001	405,099	6,280,699
Mountain	5,236	....	1,519	....	6,755
Nueva Ecija	9,184	....	8,650	....	17,834
Nueva Vizcaya	393	....	940	....	1,333
Occidental Negros	210,567	679,290	894	481,797	1,372,548
Oriental Negros	25,974	990,084	6,787	408,726	1,431,571
Palawan	34,069	199,041	32,159	22,277	287,546
Pampanga	5,486	....	....	....	5,486
Pangasinan	163,777	711,361	184,543	....	1,059,681
Rizal	212	....	....	....	212
Romblon	9,994	424,360	1,321	76,213	511,888
Samar	281,596	4,704,895	74,921	427,924	5,489,336
Sorsogon	141,964	309,336	173,309	5,833	630,442
Sulu	19,500	34,210	1,900	3,454	59,064
Surigao	13,898	1,153,093	2,052	115,153	1,284,196
Tarlac	24,794	....	6,445	....	31,239
Tayabas	34,421	11,327,339	14,465	125,877	11,502,102
Zambales	87,779	24,825	3,870	535	117,009
Zamboanga	55,994	3,262,105	26,998	61,335	3,406,432
Philippine Islands	3,951,018	59,445,977	1,427,312	11,368,223	76,192,530

Shelled corn statistics for the year ending June 30, 1921

Rank	Province	Area cultivated	Production	Average production per hectare	Average price per liter	Total value
		Hectares	*Liters*	*Liters*		
12	Abra	10,067	8,950,725	889	₱0.067	₱595,362
21	Agusan	2,826	3,607,200	1,276	.058	208,990
27	Albay	2,625	2,578,050	982	.068	175,379
29	Antique	2,865	2,452,050	856	.056	138,653
42	Bataan	767	396,450	517	.081	32,110
48	Batanes	62	38,700	624	.077	2,990
10	Batangas	19,305	14,797,650	767	.078	1,157,948
6	Bohol	27,204	24,735,375	909	.079	1,965,595
34	Bukidnon	2,051	1,506,150	734	.066	99,730
28	Bulacan	4,014	2,501,700	623	.068	169,438
5	Cagayan	22,400	24,795,525	1,107	.069	1,705,184
46	Camarines Norte	271	225,225	831	.081	18,173
35	Camarines Sur	1,572	1,479,150	941	.079	116,282
15	Capiz	5,611	4,983,150	888	.062	308,381
32	Cavite	3,088	2,012,325	652	.068	136,620
1	Cebu	165,278	184,317,900	1,115	.072	13,213,512
14	Cotabato	5,609	5,654,100	1,008	.057	324,507
26	Davao	1,999	2,774,250	1,388	.090	248,952
16	Ilocos Norte	5,772	4,592,550	796	.082	377,105
13	Ilocos Sur	9,952	8,477,850	852	.080	679,279
9	Iloilo	20,583	15,211,575	739	.085	1,297,235
4	Isabela	40,394	26,774,925	663	.092	2,452,502
37	Laguna	1,470	1,364,250	928	.067	92,037
33	Lanao	3,078	1,797,675	584	.063	112,831
17	La Union	4,932	4,264,425	865	.096	409,862
2	Leyte	36,088	40,124,550	1,112	.069	2,752,583
45	Marinduque	284	225,450	794	.048	10,724
30	Masbate	3,800	2,436,300	641	.073	176,763
38	Mindoro	1,313	747,075	569	.076	57,071
7	Misamis	25,184	24,281,175	964	.062	1,504,109
43	Mountain	432	368,025	852	.060	22,238
20	Nueva Ecija	5,767	3,699,075	641	.077	283,824
41	Nueva Vizcaya	482	418,950	869	.055	23,152
3	Occidental Negros	33,195	33,447,150	1,008	.080	2,664,849
8	Oriental Negros	29,609	23,788,575	803	.077	1,821,406
40	Palawan	774	460,500	595	.073	33,680
19	Pampanga	7,059	3,705,300	525	.081	298,942
11	Pangasinan	12,987	11,569,425	891	.079	913,456
39	Rizal	1,161	729,150	628	.094	68,775
31	Romblon	1,877	2,331,825	1,242	.078	181,027
18	Samar	4,343	3,718,125	856	.074	275,522
25	Sorsogon	2,608	2,816,325	1,080	.073	206,113
47	Sulu	600	206,250	344	.052	10,750
36	Surigao	2,451	1,472,775	601	.047	68,750
23	Tarlac	3,067	2,961,900	966	.072	212,699
22	Tayabas	3,678	3,250,200	884	.094	305,463
44	Zambales	451	315,225	699	.092	28,959
24	Zamboanga	2,823	2,937,450	1,041	.077	227,764
	Philippine Islands	543,828	516,299,700	949	.074	38.187,266

Abaca statistics for the year ending June 30, 1921

Rank	Province	Area: Cultivated	Area: Harvested	Production	Average yield per hectare	Average price per kilo	Total value
		Hectares	*Hectares*	*Kilos*	*Kilos*		
......	Abra...........						
9	Agusan...........	9,783	7,855	2,514,035	320	₱0.17	₱427,386
2	Albay...........	88,386	50,180	15,335,152	306	.22	3,344,579
26	Antique...........	914	240	117,708	490	.38	44,729
......	Bataan...........						
......	Batanes...........						
30	Batangas...........	895	94	12,081	129	.37	4,476
24	Bohol...........	1,718	788	192,660	244	.26	50,717
14	Bukidnon...........	6,711	2,668	1,082,077	405	.18	194,774
......	Bulacan...........						
......	Cagayan...........						
10	Camarines Norte.......	17,786	9,190	2,481,045	270	.33	809,569
6	Camarines Sur.........	57,941	17,863	6,147,204	344	.18	1,110,010
13	Capiz...........	6,683	3,629	1,224,457	337	.39	479,998
12	Cavite...........	12,843	6,159	1,245,695	202	.46	573,020
16	Cebu...........	7,014	2,386	698,208	293	.35	244,373
28	Cotabato...........	357	225	68,500	304	.31	21,109
3	Davao...........	34,277	24,669	14,732,035	597	.26	3,830,329
......	Ilocos Norte...........						
......	Ilocos Sur...........						
17	Iloilo...........	2,824	1,647	546,733	332	.36	197,988
......	Isabela...........						
19	Laguna...........	3,670	1,343	395,376	294	.58	227,837
25	Lanao...........	1,003	426	151,737	356	.18	27,370
......	La Union...........						
1	Leyte...........	111,431	56,440	28,317,151	502	.25	7,072,315
20	Marinduque...........	3,721	1,639	362,486	221	.28	100,591
18	Masbate...........	1,833	861	411,251	478	.32	130,304
15	Mindoro...........	4,971	2,892	1,024,144	354	.33	340,696
8	Misamis...........	13,017	6,133	2,734,229	446	.18	492,161
......	Mountain...........						
......	Nueva Ecija...........						
......	Nueva Vizcaya...........						
21	Occidental Negros......	4,931	1,808	359,385	199	.35	125,785
22	Oriental Negros........	11,506	1,358	316,501	233	.20	63,300
31	Palawan...........	7	4	2,024	506	.43	880
......	Pampanga...........						
......	Pangasinan...........						
......	Rizal...........						
27	Romblon...........	1,655	755	97,595	129	.31	30,550
5	Samar...........	47,968	25,155	9,436,187	375	.28	2,642,132
4	Sorsogon...........	61,640	38,679	13,197,176	341	.25	3,241,221
29	Sulu...........	210	210	31,625	151	.24	7,500
7	Surigao...........	25,651	12,769	3,477,160	272	.20	695,432
......	Tarlac...........						
23	Tayabas...........	1,839	667	262,487	394	.24	63,588
......	Zambales...........						
11	Zamboanga...........	4,909	2,704	1,379,426	510	.17	234,502
	Philippine Islands.	548,094	281,436	108,353,530	385	.25	26,829,221

Tobacco statistics for the year ending June 30, 1921

Rank	Province	Area cultivated	Production	Average production per hectare	Average price per kilo	Total value
		Hectares	*Kilos*	*Kilos*		
9	Abra	2,027	721,372	356	₱0.074	₱53,667
29	Agusan	140	28,152	201	.370	10,405
.....	Albay	.....	.....	.....	.....	.....
19	Antique	210	67,160	320	.237	15,899
.....	Bataan	.....	.....	.....	.....	.....
40	Batanes	9	4,692	521	.535	2,510
31	Batangas	190	20,332	107	.309	6,277
18	Bohol	421	115,920	276	.221	25,666
39	Bukidnon	58	4,922	85	.465	2,290
34	Bulacan	42	14,490	345	.146	2,120
2	Cagayan	11,570	8,181,284	707	.168	1,373,645
.....	Camarines Norte	.....	.....	.....	.....	.....
43	Camarines Sur	4	506	127	.196	99
23	Capiz	215	39,514	184	.517	20,424
33	Cavite	58	15,410	266	.069	1,070
4	Cebu	10,688	5,521,656	517	.088	483,324
25	Cotabato	213	35,374	166	.454	16,065
30	Davao	173	21,574	125	.256	5,526
6	Ilocos Norte	3,500	1,751,036	500	.126	221,042
12	Ilocos Sur	1,266	531,898	420	.111	58,998
7	Iloilo	2,927	1,327,744	454	.149	197,699
1	Isabela	27,657	17,668,922	639	.226	3,990,632
.....	Laguna	.....	.....	.....	.....	.....
21	Lanao	141	53,222	377	.400	21,274
5	La Union	8,308	4,807,782	579	.104	499,569
14	Leyte	921	433,458	471	.569	246,719
32	Marinduque	56	16,330	292	.129	2,107
20	Masbate	576	65,550	114	.274	17,950
28	Mindoro	72	31,004	431	.314	9,730
24	Misamis	142	36,294	256	.192	6,963
15	Mountain	1,213	332,488	274	.157	52,274
8	Nueva Ecija	2,302	899,622	391	.195	175,301
27	Nueva Vizcaya	86	31,740	369	.146	4,627
10	Occidental Negros	2,207	693,450	314	.193	134,150
11	Oriental Negros	1,093	570,814	522	.201	114,857
38	Palawan	13	6,440	495	.596	3,840
.....	Pampanga	.....	.....	.....	.....	.....
3	Pangasinan	10,400	7,820,322	752	.093	725,173
37	Rizal	25	7,038	282	.168	1,180
22	Romblon	155	43,424	280	.222	9,641
16	Samar	499	192,970	387	.303	58,513
42	Sorsogon	3	1,196	399	.380	455
41	Sulu	10	4,600	460	.043	200
17	Surigao	198	134,596	680	.538	72,350
13	Tarlac	1,009	490,820	486	.251	123,288
36	Tayabas	69	9,890	143	.147	1,455
35	Zambales	47	10,488	223	.122	1,277
26	Zamboanga	67	33,534	500	.218	7,323
	Philippine Islands	90,980	52,799,030	580	.166	8,777,574

Maguey statistics for the year ending June 30, 1921

Rank	Province	Area		Production	Average yield per hectare	Average price per kilo	Total value
		Cultivated	Harvested				
		Hectares	*Hectares*	*Kilos*	*Kilos*		
12	Abra	85	22	2,530	115	₱0.18	₱446
.....	Agusan	....	....	....	....	....	....
.....	Albay	....	....	....	....	....	....
14	Antique	48	6	1,075	179	.17	180
.....	Bataan	....	....	....	....	....	....
.....	Batanes	....	....	....	....	....	....
.....	Batangas	....	....	....	....	....	....
3	Bohol	3,344	2,306	672,588	292	.13	87,436
.....	Bukidnon	....	....	....	....	....	....
.....	Bulacan	....	....	....	....	....	....
.....	Cagayan	29	....	....	....	....	....
.....	Camarines Norte	....	....	....	....	....	....
.....	Camarines Sur	....	....	....	....	....	....
.....	Capiz	2	....	....	....	....	....
.....	Cavite	....	....	....	....	....	....
1	Cebu	14,289	9,017	5,756,008	638	.12	690,721
.....	Cotabato	....	....	....	....	....	....
.....	Davao	....	....	....	....	....	....
4	Ilocos Norte	4,360	1,181	441,135	374	.13	57,348
2	Ilocos Sur	5,123	2,615	1,739,881	665	.10	168,938
11	Iloilo	20	18	6,704	372	.25	1,671
.....	Isabela	....	....	....	....	....	....
.....	Laguna	....	....	....	....	....	....
.....	Lanao	....	....	....	....	....	....
13	La Union	286	10	2,214	221	.12	263
9	Leyte	544	103	14,231	138	.10	1,435
.....	Marinduque	4	....	....	....	....	....
10	Masbate	92	47	13,915	296	.12	1,615
.....	Mindoro	....	....	....	....	....	....
.....	Misamis	....	....	....	....	....	....
.....	Mountain	12	....	....	....	....	....
.....	Nueva Ecija	....	....	....	....	....	....
.....	Nueva Vizcaya	1	....	....	....	....	....
8	Occidental Negros	45	40	33,712	843	.13	4,268
6	Oriental Negros	340	221	77,734	352	.12	9,653
.....	Palawan	....	....	....	....	....	....
.....	Pamapanga	4	....	....	....	....	....
5	Pangasinan	1,542	860	372,163	433	.07	26,260
.....	Rizal	....	....	....	....	....	....
.....	Romblon	6	....	....	....	....	....
.....	Samar	2	....	....	....	....	....
.....	Sorsogon	....	....	....	....	....	....
.....	Sulu	....	....	....	....	....	....
.....	Surigao	2	....	....	....	....	....
15	Tarlac	8	2	949	475	.17	165
.....	Tayabas	....	....	....	....	....	....
7	Zambales	167	71	42,631	600	.09	3,862
.....	Zamboanga	30	....	....	....	....	....
	Philippine Islands	30,385	16,519	9,177,470	556	.11	1,054,261

Sweet potato statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	290.50	438,655	₱0.03	₱11,786
Agusan	2,662.90	4,043,080	.02	98,700
Albay	2,169.20	7,088,377	.01	85,493
Antique	1,604.80	5,140,581	.02	108,226
Bataan	102.10	453,570	.01	5,222
Batanes	207.50	1,506,450	.01	15,065
Batangas	423.50	911,490	.03	26,052
Bohol	4,129.40	7,373,506	.01	108,418
Bukidnon	1,052.00	4,898,112	.01	48,981
Bulacan	199.10	334,000	.01	4,626
Cagayan	330.00	737,713	.02	18,226
Camarines Norte	314.00	444,570	.01	5,818
Camarines Sur	1,317.20	2,260,441	.01	28,900
Capiz	2,333.50	3,159,211	.01	38,405
Cavite	277.00	79,120	.03	2,349
Cebu	2,623.80	16,243,946	.02	324,870
Cotabato	960.40	1,881,795	.02	32,438
Davao	729.00	901,360	.02	21,731
Ilocos Norte	1,611.30	2,975,986	.02	63,289
Ilocos Sur	541.20	1,483,530	.02	28,527
Iloilo	1,852.20	4,081,030	.02	96,585
Isabela	506.80	231,767	.04	9,717
Laguna	164.50	236,395	.03	6,635
Lanao	511.50	1,071,010	.02	18,915
La Union	1,053.90	1,386,643	.02	27,688
Leyte	5,410.10	34,841,044	.01	348,410
Marinduque	76.50	175.786	.02	4,025
Masbate	2,130.00	4,280.020	.01	46,023
Mindoro	1,326.00	1,957,338	.02	33,874
Misamis	1,558.50	1,557,616	.02	30,113
Mountain	4,158.50	8,293,124	.03	216,832
Nueva Ecija	115.30	333,413	.06	19,142
Nueva Vizcaya	229.70	1,883,540	.01	18,835
Occidental Negros	649.00	2,270,880	.02	46,058
Oriental Negros	802.50	1,369,944	.02	32,754
Palawan	1,005.50	3,179,738	.02	66,969
Pampanga	113.50	366,183	.03	11,225
Pangasinan	1,727.80	3,285,442	.02	61,692
Rizal	89.60	136,504	.03	3,414
Romblon	743.60	1,597.983	.01	19,343
Samar	7,245.60	39,850,800	.02	797,016
Sorsogon	4,498.70	6.729,980	.01	72,564
Sulu	46.00	380,052	.04	15,202
Surigao	1,466.50	1,935,960	.02	44,923
Tarlac	310.00	2,294,000	.02	45,880
Tayabas	1,514.60	2,552,968	.02	40,118
Zambales	188.40	563,952	.02	11,501
Zamboanga	188.00	1,823,600	.01	18,236
Philippine Islands	63,561.20	191,022,005	.02	3,240,811

Mongo statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	7.00	3,600	₱0.12	₱420
Agusan	28.00	2,270	.17	389
Albay	103.50	32,654	.18	5,834
Antique	1,325.00	644,776	.15	96,520
Bataan	15.50	9,506	.50	4,799
Batanes	.....	.....	.....	.....
Batangas	1,810.50	266,909	.25	67,877
Bohol	87.50	63,215	.21	13,324
Bukidnon	50.00	5,850	.43	2,500
Bulacan	2.30	4,215	.20	851
Cagayan	425.00	240,715	.29	69,813
Camarines Norte	4.00	16,000	.50	8,000
Camarines Sur	106.50	45,887	.18	8,479
Capiz	73.00	37,994	.22	8,378
Cavite	140.00	486,920	.30	146,076
Cebu	1,553.30	792,183	.22	174,280
Cotabato	44.80	5,614	.12	691
Davao	19.00	2,162	.13	278
Ilocos Norte	340.60	377,361	.13	49,552
Ilocos Sur	472.30	172,664	.16	26,786
Iloilo	560.50	2,903,458	.18	522,622
Isabela	187.90	62,011	.15	9,478
Laguna	5.00	644	.12	78
Lanao	5.00	1,100	.13	140
La Union	33.30	10,240	.16	1,595
Leyte	396.70	57,272	.33	18,718
Marinduque	5.10	1,464	.25	363
Masbate	16.00	9,610	.19	1,825
Mindoro	33.30	7,022	.20	1,377
Misamis	82.20	36,434	.26	9,291
Mountain	5.50	2,870	.19	557
Nueva Ecija	273.50	75,546	.19	14,156
Nueva Vizcaya	5.40	1,365	.19	257
Occidental Negros	110.50	15,922	.29	4,556
Oriental Negros	51.50	11,279	.30	3,418
Palawan	.....	.....	.....	.....
Pampanga	4.10	3,939	.14	535
Pangasinan	3,649.30	4,167,947	.09	375,666
Rizal	30.00	9,595	.14	1,354
Romblon	24.30	11,490	.19	2,178
Samar	4.40	7,106	.32	2,280
Sorsogon	73.00	21,041	.23	4,737
Sulu	.....	.....	.....	.....
Surigao	55.00	10,532	.21	2,248
Tarlac	48.80	209,450	.19	39,796
Tayabas	102.00	118,590	.23	27,373
Zambales	294.50	187,869	.09	16,517
Zamboanga	6.00	9,232	.21	1,920
Philippine Islands	12,671.10	11,163,523	.16	1,747,882

Gabe statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	62.80	160,932	₱0.02	₱3,152
Agusan	298.30	1,346,231	.02	33,505
Albay	534.40	1,690,066	.03	55,987
Antique	197.20	1,069,450	.02	21,170
Bataan	55.50	246,908	.02	4,313
Batanes	30.80	211,359	.02	4,108
Batangas	90.00	443,162	.02	7,099
Bohol	110.60	188,582	.02	3,533
Bukidnon	137.00	237,626	.02	5,251
Bulacan	132.80	1,694,815	.01	18,865
Cagayan	278.20	934,559	.04	35,529
Camarines Norte	147.00	140,020	.05	6,794
Camarines Sur	694.20	1,189,227	.06	67,448
Capiz	323.00	800,716	.04	34,803
Cavite	142.50	959,600	.01	10,744
Cebu	255.30	386,610	.05	20,344
Cotabato	111.40	1,508,420	.05	70,674
Davao	255.00	205,720	.03	5,625
Ilocos Norte	811.20	1,248,492	.03	36,979
Ilocos Sur	41.00	226,615	.03	7,509
Iloilo	349.60	923,711	.03	28,458
Isabela	188.30	307,416	.05	14,571
Laguna	129.30	274,718	.04	10,145
Lanao	57.50	93,925	.03	3,184
La Union	117.60	343,600	.03	11,601
Leyte	755.60	6,138,638	.02	151,338
Marinduque	54.60	122,890	.05	5,837
Masbate	55.60	81,700	.03	2,820
Mindoro	103.80	190,210	.05	10,345
Misamis	85.30	379,580	.04	13,620
Mountain	1,192.80	4,423,830	.04	185,834
Nueva Ecija	60.20	318,240	.05	14,527
Nueva Vizcaya	49.90	227,198	.04	8,974
Occidental Negros	91.60	641,817	.02	12,059
Oriental Negros	142.10	302,567	.04	12,160
Palawan	21.80	81,250	.02	1,750
Pampanga	8.10	9,846	.06	562
Pangasinan	240.00	2,071,294	.04	86,679
Rizal	42.00	71,876	.04	3,144
Romblon	127.70	407,600	.03	10,755
Samar	810.30	3,142,599	.03	86,862
Sorsogon	516.40	1,154,140	.04	44,620
Sulu	2.00	10,000	.05	500
Surigao	185.00	393,332	.03	9,933
Tarlac	50.10	241,860	.05	12,019
Tayabas	291.30	509,181	.04	19,631
Zambales	67.20	195,060	.03	4,953
Zamboanga	63.00	811,768	.02	20,084
Philippine Islands	10,016.90	38,703,956	.03	1,240,397

Tomato statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	72.40	105,468	₱0.11	₱12,053
Agusan	100.70	86,162	.08	6,677
Albay	88.90	106,148	.11	11,816
Antique	60.50	86,290	.16	13,963
Bataan	65.60	125,152	.08	9,574
Batanes	......	......	......	......
Batangas	184.70	200,658	.09	17,955
Bohol	218.60	134,437	.12	16,574
Bukidnon	87.00	55,700	.14	7,973
Bulacan	206.80	252,841	.11	28,634
Cagayan	511.50	930,670	.08	72,256
Camarines Norte	4.50	5,250	.10	549
Camarines Sur	138.50	250.540	.05	12,826
Capiz	83.40	168,078	.08	14,019
Cavite	124.60	122,022	.14	17,052
Cebu	622.00	789,349	.10	77,607
Cotabato	40.00	45,300	.13	5,954
Davao	14.00	16,830	.10	1,728
Ilocos Norte	1,301.00	1,113,590	.12	130,184
Ilocos Sur	471.40	439,413	.11	47,432
Iloilo	495.70	443,252	.10	44,347
Isabela	91.00	69,653	.12	8,608
Laguna	29.00	27,080	.11	2,943
Lanao	23.00	23,545	.15	3,502
La Union	222.20	160,043	.12	18,592
Leyte	315.20	334,285	.09	30,471
Marinduque	10.50	14,450	.15	2,145
Masbate	170.00	71,400	.12	8,568
Mindoro	28.50	19,150	.13	2,489
Misamis	57.90	54,892	.10	5,421
Mountain	126.60	79,744	.06	4,942
Nueva Ecija	384.80	262,461	.10	26,116
Nueva Vizcaya	24.70	20,900	.16	3,391
Occidental Negros	173.50	208,870	.10	21,074
Oriental Negros	19.70	20,680	.09	1,774
Palawan	12.00	15,600	.10	1,560
Pampanga	72.70	90,080	.09	8,442
Pangasinan	814.90	683,579	.09	61,183
Rizal	96.50	86,480	.10	8,479
Romblon	103.90	55,386	.16	8,659
Samar	98.80	87,495	.08	7,341
Sorsogon	99.10	107,115	.08	8,884
Sulu	4.00	2,094	.12	253
Surigao	35.40	15,786	.15	2,297
Tarlac	162.10	109,701	.10	11,490
Tayabas	247.70	175,850	.11	19,611
Zambales	59.10	83,070	.10	8,117
Zamboanga	36.00	27,030	.10	2,702
Philippine Islands	8,410.60	8,383,569	.10	838.177

Ubi statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	43.30	25,752	₱0.008	₱216
Agusan	25.00	225,000	.04	9,000
Albay	70.40	115,936	.01	1,614
Antique	26.50	126,140	.10	12,614
Bataan	10.10	18,080	.08	1,513
Batanes	373.00	258,084	.05	13,305
Batangas	29.00	12,656	.10	1,263
Bohol	1,607.50	3,054,859	.03	96,054
Bukidnon	250.00	256,800	.04	1,000
Bulacan	3.00	13,100	.04	539
Cagayan	67.80	85,455	.09	7,993
Camarines Norte	2.00	2,000	.10	200
Camarines Sur	45.00	27,012	.09	2,550
Capiz	42.20	56,635	.08	4,673
Cavite	....	....	....	....
Cebu	475.10	3,800,800	.09	342,072
Cotabato	11.80	13,300	.10	1,274
Davao	6.00	3,100	.10	310
Ilocos Norte	83.00	23,955	.07	1,698
Ilocos Sur	12.00	7,101	.06	404
Iloilo	101.70	680,067	.10	68,007
Isabela	57.10	9,599	.10	920
Laguna	104.00	99,215	.04	4,343
Lanao	9.50	12,165	.17	2,086
La Union	64.30	250,770	.07	17,554
Leyte	756.50	1,286,050	.05	64,303
Marinduque	.10	100	.10	10
Masbate	186.00	235,280	.04	10,459
Mindoro	32.10	27,172	.07	1,927
Misamis	119.90	110,650	.09	9,457
Mountain	133.50	138,000	.06	8,411
Nueva Ecija	10.60	27,150	.15	3,951
Nueva Vizcaya	4.30	4,280	.10	428
Occidental Negros	93.00	74,808	.08	5,750
Oriental Negros	96.20	110,679	.05	5,515
Palawan	86.00	58,000	.03	1,520
Pampanga	.10	334	.06	19
Pangasinan	30.40	141,968	.05	7,098
Rizal	16.00	15,389	.04	614
Romblon	83.90	731,947	.008	5,555
Samar	513.70	536,633	.05	27,997
Sorsogon	39.10	72,460	.03	2,389
Sulu	.50	500	.10	50
Surigao	106.50	163,954	.03	5,056
Tarlac	9.30	5,488	.03	160
Tayabas	98.00	157,951	.05	8,618
Zambales	28.90	75,400	.09	6,620
Zamboanga	9.00	11,550	.03	297
Philippine Islands	5,972.90	13,163,324	.06	767,406

Eggplant statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per fruit	Total value
	Hectares	*Fruits*		
Abra	347.30	1,133,819	₱0.008	₱9,096
Agusan	80.50	469,400	.006	2,612
Albay	143.80	1,035,031	.005	5,532
Antique	57.00	278,900	.005	1,265
Bataan	56.40	1,431,588	.005	7,626
Batanes	.10	500	.01	5
Batangas	250.30	3,237,109	.005	16,941
Bohol	188.00	689,109	.007	4,683
Bukidnon	22.00	158.220	.009	1,434
Bulacan	269.70	4,768,148	.008	36,283
Cagayan	288.90	14,074,005	.006	78,283
Camarines Norte	56.60	798,000	.004	2,906
Camarines Sur	455.00	5,894,210	.005	27,114
Capiz	99.00	887,043	.006	5,748
Cavite	207.00	1,600,620	.006	9,512
Cebu	501.40	4,196,057	.007	27,690
Cotabato	137.80	712,870	.005	3,890
Davao	59.20	403,660	.004	1,464
Ilocos Norte	2,160.40	47,267,710	.003	146,567
Ilocos Sur	479.60	13,914,773	.004	55,357
Iloilo	971.60	13,216,129	.005	60,403
Isabela	449.30	4,728,408	.008	38,810
Laguna	112.00	667,730	.008	5,021
Lanao	32.00	176,650	.006	1,126
La Union	428.90	2,360,335	.006	14,002
Leyte	491.00	3,794,838	.005	17,665
Marinduque	32.20	174,396	.006	985
Masbate	87.50	700,521	.006	4,536
Mindoro	58.00	260,922	.007	1,724
Misamis	89.90	429,358	.006	2,638
Mountain	54.20	314,100	.006	1,981
Nueva Ecija	187.90	1,445,272	.006	8,074
Nueva Vizcaya	59.90	419,610	.007	2,784
Occidental Negros	217.90	1,302,870	.007	8,929
Oriental Negros	150.20	1,099,002	.005	5,986
Palawan	14.50	125,715	.004	503
Pampanga	91.20	1,341,694	.01	13,033
Pangasinan	576.40	3,939,498	.005	19,562
Rizal	467.10	5,506,358	.003	17,369
Romblon	45.80	1,781,560	.004	7,136
Samar	187.40	2,817,437	.009	25,077
Sorsogon	233.40	1,284,990	.005	6,271
Sulu	4.00	24,600	.009	233
Surigao	81.00	1,640,550	.002	2,949
Tarlac	232.50	1,902,074	.004	7,829
Tayabas	496.20	3,190,497	.007	22,793
Zambales	125.00	576,531	.006	3,349
Zamboanga	30.20	169,635	.01	1,654
Philippine Islands	11,867.20	158,342,052	.005	746,430

Cassava statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	20.80	34,650	₱0.02	₱710
Agusan	113.30	213,977	.02	4,986
Albay	551.20	2,211,433	.03	63,271
Antique	371.00	2,431,283	.01	35,901
Bataan	5.60	7,610	.01	85
Batanes	......	......	......	......
Batangas	364.70	1,127,075	.06	68,297
Bohol	477.30	995,612	.03	25,398
Bukidnon	474.50	1,282,360	.02	22,829
Bulacan	2.00	10,000	.03	300
Cagayan	13.60	43,685	.02	717
Camarines Norte	130.00	173,418	.02	3,865
Camarines Sur	623.00	1,985,790	.03	50,078
Capiz	350.60	446,622	.05	20,374
Cavite	95.00	135,000	.02	2,700
Cebu	1,571.20	4,054,697	.02	68,184
Cotabato	432.80	358,545	.02	7,747
Davao	9.50	13,812	.02	276
Ilocos Norte	26.00	73,510	.02	1,630
Ilocos Sur	14.70	6,256	.04	267
Iloilo	359.30	613,188	.02	11,387
Isabela	8.00	12,950	.02	259
Laguna	195.00	142,321	.04	5,606
Lanao	274.00	703,565	.02	12,747
La Union	203.70	883,208	.01	11,203
Leyte	786.00	1,186,416	.02	23,151
Marinduque	34.80	92,282	.02	2,002
Masbate	352.00	417,085	.03	11,570
Mindoro	106.00	125,904	.02	3,102
Misamis	42.90	88,441	.02	2,192
Mountain	59.00	158,208	.01	1,664
Nueva Ecija	20.00	2,138	.08	178
Nueva Vizcaya	59.90	11,788	.05	589
Occidental Negros	213.00	441,285	.02	7,908
Oriental Negros	937.00	1,206,711	.02	29,689
Palawan	1,250.00	1,901,320	.03	56,050
Pampanga	......	......	......	......
Pangasinan	56.80	52,733	.02	1,056
Rizal	39.00	59,084	.02	1,010
Romblon	95.80	234,806	.01	3,043
Samar	1,255.20	1,112,805	.02	21,142
Sorsogon	1,365.00	1,237,038	.02	21,289
Sulu	......	......	......	......
Surigao	326.50	235,952	.02	3,649
Tarlac	6.20	6,971	.02	150
Tayabas	902.70	1,085,154	.03	28,182
Zambales	126.00	1,179,390	.01	13,223
Zamboanga	357.00	587,576	.01	7,554
Philippine Islands	15,077.60	29,383,654	.02	657,210

Bean statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	217.10	56,129	₱0.11	₱6,247
Agusan	64.00	12,769	.16	2,046
Albay	191.80	50,524	.15	7,645
Antique	101.00	25,631	.32	8,087
Bataan	25.90	10,445	.13	1,362
Batanes				
Batangas	494.20	86,433	.12	10,737
Bohol	198.20	40,727	.20	8,187
Bukidnon	105.00	37,193	.20	7,622
Bulacan	50.20	20,436	.12	2,388
Cagayan	627.10	365,191	.32	118,569
Camarines Norte	4.00	2,511	.05	126
Camarines Sur	144.80	31,617	.19	6,147
Capiz	149.90	50,534	.28	13,976
Cavite	67.00	13,220	.24	3,214
Cebu	144.50	44,293	.19	8,403
Cotabato	30.80	10,428	.13	1,368
Davao	53.20	11,240	.17	1,934
Ilocos Norte	948.80	447,868	.19	85,405
Ilocos Sur	411.00	175,988	.24	41,678
Iloilo	779.90	92,950	.30	28,098
Isabela	547.20	128,043	.33	41,676
Laguna	176.50	15,907	.21	3,401
Lanao	37.00	230	.73	168
La Union	414.00	96,157	.32	31,091
Leyte	146.00	14,797	.23	3,379
Marinduque	6.00	1,392	.13	180
Masbate	6.00	2,708	.04	118
Mindoro	4.00	292	.19	55
Misamis	126.70	25,601	.36	9,108
Mountain	328.00	32,480	.24	7,645
Nueva Ecija	103.80	16,836	.20	3,295
Nueva Vizcaya	62.20	16,170	.27	4,344
Occidental Negros	170.10	38,910	.40	15,518
Oriental Negros	637.90	214,720	.10	20,838
Palawan	259.00	72,658	.10	7,266
Pampanga	24.10	3,914	.25	974
Pangasinan	510.40	126,046	.14	18,186
Rizal	31.00	4,816	.18	859
Romblon	47.10	7,418	.18	1,370
Samar	6.30	2,460	.19	476
Sorsogon	14.50	2,093	.24	505
Sulu	4.00	464	.10	48
Surigao	3.00	234	.43	100
Tarlac	46.00	10,040	.24	2,405
Tayabas	33.50	10,511	.34	3,543
Zambales	128.10	42,590	.13	5,547
Zamboanga	10.00	8,096	.17	1,402
Philippine Islands	8,690.80	2,481,710	.22	546,736

Peanut statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	25.80	14,047	₱0.21	₱2,949
Agusan	1.50	66	.26	17
Albay	47.40	32,202	.28	9,045
Antique	47.30	10,540	.21	2,178
Bataan	71.80	54,199	.27	14,544
Batanes				
Batangas	673.00	171,515	.21	35,281
Bohol	77.90	41,378	.27	11,076
Bukidnon	3.00	4,125	.28	1,142
Bulacan	151.10	33,574	.19	6,494
Cagayan	102.20	26,458	.21	5,510
Camarines Norte				
Camarines Sur	20.70	2,960	.39	1,160
Capiz	37.10	10,355	.28	2,850
Cavite	123.00	14,793	.27	4,019
Cebu	332.90	137,213	.29	40,358
Cotabato	80.00	32,648	.15	4,838
Davao	19.50	2,224	.19	430
Ilocos Norte	1,029.50	423,761	.31	131,718
Ilocos Sur	102.70	22,952	.23	5,335
Iloilo	133.30	26,772	.38	10,213
Isabela	199.70	107,703	.24	25,720
Laguna	19.00	39,458	.30	11,837
Lanao	128.00	39,995	.18	7,100
La Union	197.80	44,226	.63	28,013
Leyte	135.90	84,174	.25	20,794
Marinduque	4.50	796	.33	266
Masbate	20.50	1,835	.41	760
Mindoro	8.00	1,170	.32	374
Misamis	104.10	32,830	.27	8,708
Mountain	142.00	127,388	.21	27,060
Nueva Ecija	109.60	27,513	.41	11,249
Nueva Vizcaya	18.50	6,830	.39	2,630
Occidental Negros	128.00	6,806	.22	1,466
Oriental Negros	27.00	17,014	.20	3,403
Palawan				
Pampanga	58.40	21,202	.26	5,586
Pangasinan	344.90	67,967	.20	13,603
Rizal	15.50	5,091	.23	1,175
Romblon	6.40	3,005	.38	1,137
Samar	59.00	4,390	.42	1,831
Sorsogon	62.00	12,948	.21	2,750
Sulu	10.50	4,338	.12	528
Surigao	13.50	3,191	.24	766
Tarlac	154.40	7,696	.32	2,441
Tayabas	36.00	18,714	.10	1,935
Zambales	28.60	22,585	.10	2,322
Zamboanga	40.00	37,285	.12	4,494
Philippine Islands	5,151.50	1,807,932	.26	477,105

Radish statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	63.00	38,700	₱0.11	₱4,445
Agusan	3.00	4,200	.06	240
Albay	79.10	329,648	.12	38,971
Antique	37.00	2,930	.14	419
Bataan	10.80	159,140	.12	19,661
Batanes				
Batangas	29.20	27,265	.09	2,404
Bohol	68.80	29,739	.07	2,221
Bukidnon	.10	82	.12	10
Bulacan	42.10	155,533	.09	14,508
Cagayan	75.90	115,947	.11	12,426
Camarines Norte	.50	500	.10	50
Camarines Sur	27.00	13,066	.08	989
Capiz	2.00	930	.26	242
Cavite	92.50	177,017	.10	18,320
Cebu	75.30	118,029	.09	11,169
Cotabato	.80	320	.20	64
Davao	14.50	10,320	.08	864
Ilocos Norte	95.50	94,224	.09	8,666
Ilocos Sur	51.00	456,737	.08	38,390
Iloilo	83.30	72,914	.08	5,521
Isabela	90.00	290,145	.21	62,189
Laguna	71.00	84,530	.05	4,136
Lanao	2.00	44	.32	14
La Union	40.00	188,580	.10	18,948
Leyte	49.10	336,422	.07	23,026
Marinduque	.80	700	.10	70
Masbate	.50	100	.40	40
Mindoro	10.50	1,159	.10	113
Misamis	20.50	20,061	.07	1,478
Mountain	17.30	22,980	.14	3,140
Nueva Ecija	39.30	20,660	.09	1,961
Nueva Vizcaya	3.40	2,445	.07	160
Occidental Negros	103.00	138,966	.10	14,131
Oriental Negros	60.70	26,909	.07	2,016
Palawan				
Pampanga	20.00	4,560	.07	298
Pangasinan	126,70	132,511	.10	13,799
Rizal	33.30	15,710	.14	2,245
Romblon				
Samar	12.50	1,827	.26	471
Sorsogon	30.10	5,933	.23	1,340
Sulu	.50	500	.10	50
Surigao	2.00	1,100	.11	120
Tarlac	64.50	91,532	.09	8,095
Tayabas	22.30	22,300	.02	430
Zambales	95.50	788,213	.07	54,854
Zamboanga	25.10	24,550	.10	2,515
Philippine Islands	1,792.00	4,029,678	.10	395,219

Cabbage statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per head	Total value
	Hectares	*Heads*		
Abra	6.20	2,330	₱0.23	₱539
Agusan	6.50	2,750	.23	630
Albay	27.60	29,851	.22	6,588
Antique	31.00	29,000	.17	4,800
Bataan				
Batanes	.10	430	.05	215
Batangas	16.00	11,200	.25	2,800
Bohol	28.10	31,795	.21	6,761
Bukidnon	.10	63	.22	14
Bulacan	7.10	12,548	.38	4,783
Cagayan	30.00	29,599	.28	8,422
Camarines Norte				
Camarines Sur	17.20	8,600	.27	2,280
Capiz	6.10	6,158	.22	1,360
Cavite	4.00	4,000	.20	800
Cebu	95.00	81,035	.17	13,977
Cotabato				
Davao	10.00	6,000	.29	1,725
Ilocos Norte	35.30	43,550	.22	9,510
Ilocos Sur	56.10	93,709	.18	16,914
Iloilo	47.80	30,340	.23	7,038
Isabela	15.60	4,680	.50	2,328
Laguna	5.00	4,700	.23	1,070
Lanao	2.00	580	.24	140
La Union	30.90	36,006	.23	8,350
Leyte	94.70	218,392	.13	29,078
Marinduque	1.00	1,000	.15	150
Masbate				
Mindoro	.50	700	.20	140
Misamis	62.50	104,021	.09	9,481
Mountain	156.60	226,030	.18	40,265
Nueva Ecija	29.00	27,880	.21	5,724
Nueva Vizcaya	1.30	1,220	.16	199
Occidental Negros	68.10	27,600	.30	8,225
Oriental Negros	72.20	107,771	.10	11,037
Palawan				
Pampanga	3.10	1,675	.44	737
Pangasinan	100.50	228,313	.19	42,590
Rizal	15.70	9,180	.48	4,422
Romblon				
Samar	.90	600	.05	30
Sorsogon				
Sulu				
Surigao	2.00	950	.44	415
Tarlac	18.80	11,230	.28	3,168
Tayabas	2.00	1,000	.50	500
Zambales	9.70	38,800	.12	4,690
Zamboanga	2.50	6,480	.15	972
Philippine Islands	1,118.80	1,481,766	.18	262,867

Tugui statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares	*Kilos*		
Abra	24.40	49,226	₱0.02	₱743
Agusan	3.00	240	.03	6
Albay	82.90	249,149	.02	4,463
Antique	.....	.....	.....	.....
Bataan	13.10	51,145	.04	2,032
Batanes	67.00	338,326	.02	5,506
Batangas	48.50	27,574	.04	1,001
Bohol	33.30	29,100	.02	511
Bukidnon	5.00	1,070	.04	45
Bulacan	1.50	1,450	.03	43
Cagayan	179.50	217,236	.03	5,602
Camarines Norte	43.00	92,920	.03	2,866
Camarines Sur	44.00	109,038	.02	2,128
Capiz	10.00	4,860	.02	101
Cavite	14.50	20,700	.02	331
Cebu	481.00	124,360	.04	5,051
Cotabato	1.50	6,500	.05	305
Davao	.....	.....	.....	.....
Ilocos Norte	275.20	786,920	.01	11,373
Ilocos Sur	115.40	226,802	.02	3,794
Iloilo	29.00	41,100	.02	888
Isabela	73.20	225,024	.02	3,757
Laguna	88.00	576,330	.03	18,201
Lanao	.....	.....	.....	.....
La Union	148.90	369,336	.01	4,301
Leyte	33.00	66,600	.02	1,302
Marinduque	4.50	6,500	.03	196
Masbate	37.00	199,940	.02	3,970
Mindoro	34.00	60,640	.04	2,296
Misamis	.....	.....	.....	.....
Mountain	149.50	169,888	.02	3,092
Nueva Ecija	68.30	41,696	.02	740
Nueva Vizcaya	121.20	885,067	.04	36,942
Occidental Negros	27.00	44,200	.01	534
Oriental Negros	26.00	37,361	.01	404
Palawan	.50	500	.01	5
Pampanga	.....	.....	.....	.....
Pangasinan	200.30	624,835	.01	6,034
Rizal	20.00	36,949	.02	831
Rombolon	51.90	51,533	.02	1,278
Samar	50.50	55,240	.03	1,771
Sorsogon	.....	.....	.....	.....
Sulu	.....	.....	.....	.....
Surigao	.....	.....	.....	.....
Tarlac	23.30	21,480	.01	235
Tayabas	174.30	240,662	.03	6,316
Zambales	25.20	40,671	.02	804
Zamboanga	2.50	4,836	.07	324
Philippine Islands	2,830.90	6,137,004	.02	140,122

Irish potato statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares.	*Kilos*		
Abra				
Agusan				
Albay				
Antique				
Bataan				
Batanes				
Batangas				
Bohol	3.00	750	₱0.10	₱75
Bukidnon				
Bulacan				
Cagayan	8.80	3,551	.37	1,310
Camarines Norte				
Camarines Sur				
Capiz	1.00	500	.20	100
Cavite				
Cebu	21.60	11,089	.33	3,654
Cotabato				
Davao				
Ilocos Norte	12.60	17,077	.06	1,025
Ilocos Sur	1.50	2,300	.50	1,150
Iloilo				
Isabela				
Laguna				
Lanao	10.00	6,075	.15	912
La Union	1.50	130	.11	14
Leyte	18.00	41,667	.06	2,500
Marinduque				
Masbate				
Mindoro				
Misamis				
Mountain	14.80	3,937	.12	469
Nueva Ecija	2.10	610	.10	61
Nueva Vizcaya	27.60	8,291	.25	2,083
Occidental Negros	113.00	15,913	.08	1,273
Oriental Negros	55.00	1,851	.15	276
Palawan				
Pampanga	.40	574	.90	517
Pangasinan	22.00	51,400	.10	5,140
Rizal				
Romblon				
Samar				
Sorsogon				
Sulu				
Surigao				
Tarlac	9.50	1,040	.10	104
Tayabas				
Zambales				
Zamboanga				
Philippine Islands	322.40	166,755	.12	20,663

Bananas statistics for the year ending June 30, 1921

Province	Plants cultivated	Production	Average price per bunch	Total value
		Bunches		
Abra	111,462	77,230	₱0.49	₱38,125
Agusan	753,354	725,154	.30	218,812
Albay	1,213,864	1,212,082	.29	351,062
Antique	1,325,855	1,361,121	.43	585,414
Bataan	537,959	588,826	.62	365,796
Batanes	21,550	21,710	.43	9,382
Batangas	3,060,768	3,587,334	.22	806,216
Bohol	1,965,995	1,801,453	.52	931,271
Bukidnon	42,423	39,286	.20	7,909
Bulacan	371,374	392,902	.85	337,540
Cagayan	2,506,912	2,653,416	.32	855,622
Camarines Norte	316,610	266,647	.51	135,712
Camarines Sur	1,303,712	1,176,200	.31	364,807
Capiz	1,053,676	805,464	.63	504,981
Cavite	564,344	502,614	.72	359,540
Cebu	7,151,403	6,095,469	.58	3,505,287
Cotabato	2,214,774	2,096,972	.20	415,641
Davao	174,187	107,618	.69	74,082
Ilocos Norte	2,562,558	1,853,721	.48	884,539
Ilocos Sur	481,107	476,966	.45	216,920
Iloilo	2,790,726	2,609,523	.53	1,394,598
Isabela	310,794	279,868	.48	133,596
Laguna	408,953	355,430	.51	180,899
Lanao	273,410	265,644	.81	217,312
La Union	531,306	478,378	.57	273,520
Leyte	3,852,142	3,692,789	.36	1,315,076
Marinduque	108,251	98,250	.46	45,056
Masbate	289,580	242,650	.25	60,365
Mindoro	208,663	191,078	.43	82,755
Misamis	1,359,691	1,071,320	.39	421,682
Mountain	154,250	117,662	.42	48,870
Nueva Ecija	1,011,133	916,756	.50	456,386
Nueva Vizcaya	42,700	44,657	.84	37,479
Occidental Negros	1,649,493	1,639,066	.83	1,357,374
Oriental Negros	2,263,693	2,206,317	.41	895,494
Palawan	656,759	653,913	.36	235,921
Pampanga	453,730	456,318	1.01	459,566
Pangasinan	3,345,510	3,886,470	.54	2,104,418
Rizal	797,075	1,000,609	.62	616,637
Romblon	191,229	127,887	.47	59,894
Samar	2,864,954	3,099,817	.39	1,122,833
Sorsogon	1,208,175	1,544,176	.34	731,622
Sulu	296,225	251,288	.29	72,924
Surigao	406,842	520,112	.43	225,805
Tarlac	224,433	264,023	.61	162,238
Tayabas	588,338	554,761	.60	331,504
Zambales	321,814	308,639	1.00	309,580
Zamboanga	1,127,114	932,796	.47	437,019
Philippine Islands	55,470,870	53,652,382	.46	24,759,081

Mango statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	5,484	481,890	₱0.02	₱8,541
Agusan	190	100,583	.02	2,011
Albay	1,087	63,940	.02	1,279
Antique	17,044	2,591,800	.02	63,650
Bataan	10,054	1,786,500	.04	64,105
Batanes				
Batangas	21,455	3,212,000	.04	126,511
Bohol	5,292	536,284	.05	25,865
Bukidnon	774	147,000	.02	2,940
Bulacan	41,762	13,053,000	.07	882,748
Cagayan	7,307	5,026,281	.03	146,799
Camarines Norte	67	2,107	.09	185
Camarines Sur	5,074	710,377	.03	21,035
Capiz	20,556	2,724,280	.06	157,074
Cavite	28,247	1,348,300	.04	51,685
Cebu	23,651	6,311,769	.03	187,514
Cotabato	2,854	272,192	.04	11,660
Davao	1,494	1,088,400	.02	20,966
Ilocos Norte	25,081	4,357,284	.03	126,906
Ilocos Sur	8,224	829,854	.03	23,677
Iloilo	78,510	8,586,046	.05	470,201
Isabela	8,778	2,741,000	.06	160,697
Laguna	4,205	239,840	.05	12,132
Lanao	9,023	752,700	.01	7,680
La Union	9,284	2,861,500	.04	102,892
Leyte	1,105	42,510	.05	2,095
Marinduque	4,004	576,600	.05	28,830
Masbate	1,791	100,000	.10	10,000
Mindoro	7,655	745,000	.05	39,330
Misamis	11,563	3,692,098	.03	107,210
Mountain	2,241	333,498	.02	6,826
Nueva Ecija	38,518	18,130,915	.03	622,654
Nueva Vizcaya	2,654	1,782,048	.03	50,292
Occidental Negros	7,934	2,166,165	.10	211,672
Oriental Negros	9,301	2,830,146	.02	52,657
Palawan	2,650	337,000	.02	7,443
Pampanga	11,649	3,666,398	.04	151,597
Pangasinan	68,682	23,392,455	.02	523,305
Rizal	12,060	1,197,659	.04	44,839
Romblon	382	30,400	.03	932
Samar	1,217	15,095	.10	1,512
Sorsogon	242	15,770	.11	1,695
Sulu	16,000	1,600,000	.01	8,000
Surigao	3,129	181,074	.02	3,021
Tarlac	8,558	4,104,200	.02	92,049
Tayabas	8,985	609,888	.04	26,931
Zambales	6,091	607,535	.03	16,883
Zamboanga	4,441	528,900	.01	6,278
Philippine Islands	**566,349**	**126,510,281**	**.04**	**4,693,904**

Cacao statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra	1,814	286	₱1.57	₱448
Agusan	50,398	17,570	.97	17,054
Albay	34,356	12,929	1.17	15,171
Antique	19,282	13,252	2.02	26,812
Bataan	7,137	3,159	2.02	6,375
Batanes				
Batangas	56,640	24,079	1.43	34,470
Bohol	131,869	86,082	1.18	101,577
Bukidnon	5,300	2,290	.69	1,577
Bulacan	9,700	3,287	1.71	5,620
Cagayan	13,978	5,383	1.50	8,079
Camarines Norte	13,688	7,194	1.44	10,344
Camarines Sur	69,568	37,981	2.03	77,089
Capiz	20,903	12,384	.85	10,476
Cavite	125,635	52,771	1.68	88,749
Cebu	131,965	183,149	1.36	249,083
Cotabato	3,224	2,328	2.00	4,646
Davao	4,000	1,300	.96	1,250
Ilocos Norte	22,974	5,354	1.19	6,354
Ilocos Sur	7,386	6,899	1.60	11,052
Iloilo	124,097	15,102	2.00	30,215
Isabela	6,896	778	1.65	1,281
Laguna	24,212	13,474	1.28	17,242
Lanao	7,110	5,980	.96	5,768
La Union	68,674	95,200	1.53	145,656
Leyte	46,918	25,043	1.59	39,887
Marinduque	7,330	1,530	.85	1,295
Masbate	2,055	960	1.50	1,440
Mindoro	22,944	18,093	1.20	21,734
Misamis	20,200	10,846	1.29	14,021
Mountain	20,431	5,620	.92	5,152
Nueva Ecija	8,730	4,934	1.22	6,035
Nueva Vizcaya	3,009	1,729	1.18	2,036
Occidental Negros	75,843	27,664	1.04	28,733
Oriental Negros	187,013	41,977	1.32	55,477
Palawan	6,378	1,012	2.13	2,153
Pampanga	6,521	5,333	1.48	7,889
Pangasinan	73,628	54,950	1.56	85,722
Rizal	8,112	2,885	1.10	3,181
Romblon	5,099	1,362	1.05	1,433
Samar	31,135	19,957	1.36	27,151
Sorsogon	33,987	7,399	1.52	11,282
Sulu				
Surigao	31,993	12,506	1.35	16,919
Tarlac	3,276	2,882	1.40	4,034
Tayabas	91,097	28,358	1.63	46,220
Zambales	6,823	4,859	1.79	8,684
Zamboanga	2,925	830	1.00	834
Philippine Islands	1,656,253	888,940	1.43	1,267,700

Papaya statistics for the year ending June 30, 1921

Rank	Province	Trees cultivated	Production	Average price per fruit	Total value
			Fruits		
44	Abra	7,889	115,953	₱0.03	₱2,978
12	Agusan	964,185	2,913,833	.01	29,635
8	Albay	206,944	2,297,240	.02	41,487
40	Antique	39,785	501,635	.01	4,858
5	Bataan	45,288	763,794	.06	44,686
48	Batanes	3,338	28,715	.02	574
14	Batangas	34,121	652,987	.04	26,116
16	Bohol	49,007	670,840	.04	25,475
46	Bukidnon	5,012	36,793	.05	1,681
32	Bulacan	10,962	180,511	.06	10,263
25	Cagayan	55,697	1,454,084	.01	14,747
21	Camarines Norte	34,351	562,850	.03	16,146
3	Camarines Sur	189,214	4,036,390	.03	106,827
18	Capiz	43,865	784,030	.02	19,353
13	Cavite	41,580	598,935	.05	29,196
1	Cebu	305,385	7,024,611	.02	165,568
28	Cotabato	16,441	220,990	.06	13,130
26	Davao	10,540	72,980	.19	13,697
17	Ilocos Norte	68,084	1,642,431	.01	21,177
6	Ilocos Sur	48,343	1,358,266	.03	43,870
24	Iloilo	60,601	1,447,644	.01	14,899
42	Isabela	17,692	245,589	.01	3,566
22	Laguna	33,491	334,719	.05	15,672
43	Lanao	4,268	56,148	.06	3,156
38	La Union	32,859	455,286	.02	6,889
2	Leyte	277,012	3,764,929	.04	153,658
34	Marinduque	10,200	222,800	.03	7,740
19	Masbate	103,304	886,600	.02	18,480
29	Mindoro	41,744	715,722	.02	10,752
23	Misamis	11,938	350,932	.04	15,060
30	Mountain	13,709	237,260	.04	10,588
7	Nueva Ecija	41,992	1,471,645	.03	41,532
45	Nueva Vizcaya	12,329	131,609	.02	2,415
11	Occidental Negros	56,976	1,965,674	.02	34,481
4	Oriental Negros	94,120	3,329,124	.02	73,379
36	Palawan	17,270	232,180	.03	7,384
31	Pampanga	12,507	211,220	.05	10,486
15	Pangasinan	93,047	1,975,554	.01	25,896
20	Rizal	26,386	280,567	.06	17,607
35	Romblon	12,536	190,610	.04	7,542
39	Samar	40,290	362,054	.02	6,850
9	Sorsogon	91,223	2,281,762	.02	41,227
47	Sulu	3,445	114,500	.01	1,440
41	Surigao	16,605	207,399	.02	4,320
37	Tarlac	9,368	241,595	.03	7,169
10	Tayabas	242,275	2,907,106	.01	41,153
27	Zambales	12,910	389,691	.03	13,452
23	Zamboanga	24,272	104,088	.08	8,716
	Philippine Islands	3,594,400	51,031,875	.02	1,236,973

Coffee statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra	12,990	3,476	₱0.73	₱2,522
Agusan	18,280	4,145	1.04	4,301
Albay	12,592	959	1.16	1,113
Antique	39,518	11,693	.97	11,374
Bataan	4,411	1,588	1.59	2,525
Batanes	50	16	.75	12
Batangas	246,769	152,780	1.15	175,697
Bohol	39,547	9,010	1.18	10,649
Bukidnon	32,505	32,900	.37	12,129
Bulacan	9,166	2,084	1.53	3,198
Cagayan	23,529	7,091	1.28	9,051
Camarines Norte	518	287	1.08	310
Camarines Sur	19,335	6,850	.88	6,013
Capiz	21,881	3,497	.93	3,255
Cavite	228,022	195,400	.96	187,584
Cebu	51,545	26,937	.51	13,656
Cotabato	2,073	621	1.35	841
Davao	5,790	3,136	1.45	4,537
Ilocos Norte	42,033	18,739	1.30	24,310
Ilocos Sur	30,744	19,098	.82	15,737
Iloilo	262,490	98,088	1.54	151,056
Isabela	3,642	1,208	1.36	1,641
Laguna	10,798	2,662	1.21	3,233
Lanao	47,580	30,676	.88	27,065
La Union	74,408	94,380	.93	87,773
Leyte	11,416	7,010	1.26	8,806
Marinduque	15,060	10,250	.53	5,426
Masbate	385	76	1.22	93
Mindoro	26,578	11,370	1.11	12,589
Misamis	29,261	17,934	1.47	26,323
Mountain	458,805	107,600	.66	71,262
Nueva Ecija	23,568	9,874	.90	8,921
Nueva Vizcaya	13,078	7,605	.76	5,787
Occidental Negros	9,982	5,058	1.20	6,052
Oriental Negros	93,539	101,626	.86	87,398
Palawan	6,571	2,289	1.48	3,391
Pampanga	7,182	2,600	1.17	3,038
Pangasinan	71,031	22,168	.97	21,561
Rizal	11,857	2,876	.89	2,571
Romblon	2,260	484	1.68	814
Samar	12,544	2,845	1.54	4,395
Sorsogon	5,241	1,548	1.39	2,153
Sulu	1,000	64	.63	40
Surigao	5,068	1,300	1.85	2,411
Tarlac	5,510	6,379	1.13	7,182
Tayabas	34,969	9,132	1.12	10,262
Zambales	7,239	1,813	1.00	1,808
Zamboanga	4,127	3,076	.82	2,520
Philippine Islands	2,096,487	1,062,298	.99	1,054,385

Lanzones statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kaing	Total value
		Kaing		
Abra				
Agusan	3,203	1,897	₱3.86	₱7,320
Albay	124	20	5.85	117
Antique				
Bataan	3			
Batanes				
Batangas	1,030	138	8.32	1,148
Bohol	6,737	2,429	2.16	5,248
Bukidnon	150	150	5.00	750
Bulacan	139	19	4.95	94
Cagayan	12	1	10.00	10
Camarines Norte	1,939	130	3.00	390
Camarines Sur	570	51	7.84	400
Capiz	12	3	16.67	50
Cavite	1,400	150	10.00	1,501
Cebu	1,748	1,297	3.73	4,835
Cotabato	200	250	3.30	825
Davao	4,370	838	12.69	10,632
Ilocos Norte	75			
Ilocos Sur	2			
Iloilo	348	71	5.00	355
Isabela				
Laguna	61,902	152,535	4.28	652,498
Lanao	2,260	1,100	4.64	5,108
La Union	1			
Leyte	10,191	3,593	3.29	11,832
Marinduque	2,400	28	5.96	167
Masbate				
Mindoro	898	189	7.41	1,400
Misamis	15,279	21,713	2.96	64,319
Mountain				
Nueva Ecija				
Nueva Vizcaya	1			
Occidental Negros	1,612	494	5.18	2,557
Oriental Negros	309	218	2.65	578
Palawan				
Pampanga	37	20	7.30	146
Pangasinan	11			
Rizal	52	10	3.00	30
Romblon				
Samar	2,438	692	5.69	3,937
Sorsogon	3			
Sulu				
Surigao	425	89	2.83	252
Tarlac	2			
Tayabas	8,691	13,846	3.47	48,110
Zambales	9			
Zamboanga	10,422	2,644	1.66	4,384
Philippine Islands	139,005	204,615	4.05	828,993

Pilinuts statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra	1,230	6	₱0.17	₱1
Agusan				
Albay	41,091	1,042,781	.08	83,888
Antique	4,015	8,000	.09	720
Bataan				
Batanes				
Batangas				
Bohol	115	2,518	.25	630
Bukidnon				
Bulacan				
Cagayan				
Camarines Norte	8,725	89,894	.16	14,025
Camarines Sur	38,938	455,058	.10	44,414
Capiz	65	7	1.00	7
Cavite				
Cebu	445	2,529	.35	885
Cotabato				
Davao				
Ilocos Norte	1,500	943	.10	92
Ilocos Sur				
Iloilo	420	3,900	.25	990
Isabela	90	878	.10	90
Laguna				
Lanao				
La Union				
Leyte	8,375	42,514	.12	5,314
Marinduque	6,000	51,921	.20	10,411
Masbate	2,460	31,275	.04	1,360
Mindoro	3,290	5,069	.26	1,334
Misamis				
Mountain				
Nueva Ecija	400	2,000	.10	200
Nueva Vizcaya				
Occidental Negros	2,500	19,399	.45	8,755
Oriental Negros				
Palawan	43			
Pampanga				
Pangasinan	5,250	9,303	.09	8,373
Rizal	24	4	1.00	4
Romblon	188	2,040	.10	204
Samar	35,246	459,174	.09	42,937
Sorsogon	25,760	772,211	.05	40,622
Sulu				
Surigao	861	2,367	.09	224
Tarlac	100			
Tayabas	88,860	649,004	.26	170,923
Zambales	5			
Zamboanga				
Philippine Islands	275,996	3,652,795	.12	436,403

Pineapple statistics for the year ending June 30, 1921

Province	Plants cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	68,951	47,776	₱0.06	₱2,974
Agusan	126,450	129,233	.05	6,969
Albay	143,432	87,571	.05	4,417
Antique	170,533	37,039	.02	919
Bataan	230,710	242,153	.05	13,030
Batanes	11,470	7,700	.01	77
Batangas	1,072,853	771,351	.05	39,174
Bohol	36,487	31,355	.05	1,515
Bukidnon	14,700	13,335	.14	1,819
Bulacan	147,430	153,317	.05	7,676
Cagayan	82,444	51,331	.02	1,067
Camarines Norte	32,910	27,360	.04	962
Camarines Sur	81,482	39,775	.05	1,870
Capiz	363,662	140,916	.03	3,647
Cavite	92,420	98,200	.04	4,208
Cebu	259,783	145,100	.04	6,474
Cotabato	734	450	.19	85
Davao	31,380	12,932	.06	727
Ilocos Norte	60,894	57,667	.04	2,073
Ilocos Sur	184,416	179,360	.04	7,735
Iloilo	75,537	58,773	.05	2,759
Isabela	38,942	29,320	.10	2,959
Laguna	32,360	19,673	.05	958
Lanao	7,245	2,292	.23	526
La Union	399,314	264,467	.07	18,921
Leyte	609,023	628,436	.05	29,524
Marinduque	25,485	23,366	.03	789
Masbate	65,957	39,891	.05	1,966
Mindoro	13,018	12,094	.03	381
Misamis	104,395	58,000	.03	1,565
Mountain	57,127	36,806	.05	1,843
Nueva Ecija	47,400	30,571	.11	3,319
Nueva Vizcaya	18,387	5,157	.06	291
Occidental Negros	135,474	87,054	.06	5,078
Oriental Negros	164,286	97,395	.03	2,623
Palawan	15,600	5,996	.10	600
Pampanga	3,774	2,729	.10	280
Pangasinan	133,732	103,030	.06	6,306
Rizal	46,420	39,652	.07	2,672
Romblon	47,778	41,380	.03	1,095
Samar	1,696,318	1,077,692	.08	84,874
Sorsogon	200,795	213,962	.04	8,943
Sulu	1,000	2,000	.05	100
Surigao	98,709	132,548	.03	4,496
Tarlac	22,691	30,110	.07	1,980
Tayabas	990,918	780,042	.05	41,137
Zambales	15,013	12,174	.08	915
Zamboanga	20,315	23,735	.10	2,314
Philippine Islands	8,300,254	6,132,266	.05	336,632

Forage grass statistics for the year ending June 30, 1921

Province	Area cultivated	Production	Average price per kilo	Total value
	Hectares.	*Kilos.*		
Abra	13.00	5,330	₱0.04	₱214
Agusan				
Albay	27.00	1,080,000	.02	21,600
Antique	58.00	50,150	.04	1,879
Bataan	35.00	145,300	.02	2,906
Batanes				
Batangas	299.00	14,455,300	.01	144,553
Bohol	62.10	320,972	.04	11,602
Bukidnon				
Bulacan	2.50	58,757	.01	733
Cagayan				
Camarines Norte				
Camarines Sur				
Capiz				
Cavite	1,188.00	4,249,200	.01	42,387
Cebu	169.00	580,660	.01	5,840
Cotabato				
Davao				
Ilocos Norte	25.00	9,700	.01	133
Ilocos Sur	3.70	5,275	.04	211
Iloilo	55.00	44,494	.02	792
Isabela				
Laguna	601.00	1,949,100	.02	36,300
Lanao				
La Union				
Leyte	82.00	1,108,025	.01	11,080
Marinduque				
Masbate				
Mindoro				
Misamis	59.20	89,200	.01	892
Mountain				
Nueva Ecija				
Nueva Vizcaya	3.00	3,450	.01	35
Occidental Negros	96.00	384,000	.01	3,840
Oriental Negros	8.00	13,500	.02	251
Palawan				
Pampanga	50.20	294,990	.01	2,950
Pangasinan	8.00	6,750	.03	189
Rizal	249.50	2,742,600	.01	33,911
Romblon				
Samar				
Sorsogon	13.00	741	.17	126
Sulu	1.00	2,000	.05	100
Surigao	75.00	139,575	.02	2,125
Tarlac	4.00	24,000	.05	1,200
Tayabas	6.00	240,000	.01	1,950
Zambales				
Zamboanga				
Philippine Islands	3,193.20	28,003,069	.01	327,799

Mandarin statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	227	21,700	₱0.02	₱377
Agusan	455	120	.01	1
Albay	6,859	350,985	.02	7,165
Antique	152	4,950	.02	99
Bataan	223	1,420	.03	39
Batanes	326	2,050	.01	23
Batangas	197,399	10,306,776	.01	136,422
Bohol	2,889	119,216	.01	1,181
Bukidnon	5,007	121,800	.05	6,090
Bulacan	1,929	81,985	.06	4,760
Cagayan	18,268	568,502	.01	5,827
Camarines Norte	325	31,733	.02	622
Camarines Sur	4,414	227,115	.02	4,171
Capiz	187	5,660	.03	172
Cavite	3,160	147,500	.02	2,285
Cebu	16,622	857,180	.01	11,908
Cotabato				
Davao	25	300	.05	15
Ilocos Norte	22,943	1,984,948	.01	20,401
Ilocos Sur	2,842	225,554	.05	10,509
Iloilo	3,099	155,429	.02	3,192
Isabela	1,759	74,575	.04	2,704
Laguna	2,649	172,190	.02	3,367
Lanao	6	240	.01	2
La Union	787	101,680	.01	1,029
Leyte	6,390	294,752	.01	3,992
Marinduque	2,065	16,640	.01	153
Masbate	8	300	.05	16
Mindoro	1,890	123,556	.02	2,451
Misamis	2,100	164,375	.01	1,282
Mountain	1,622	157,690	.01	1,614
Nueva Ecija	398	37,635	.02	844
Nueva Vizcaya	357	4,760	.01	49
Occidental Negros	4,847	221,140	.02	3,838
Oriental Negros	1,207	102,000	.02	2,088
Palawan	2,073	162,559	.01	1,575
Pampanga	52	1,230	.04	50
Pangasinan	8,616	492,338	.01	7,060
Rizal	1,106	7,070	.04	285
Romblon	2,653	356,150	.01	2,250
Samar	2,380	32,250	.01	271
Sorsogon	1,491	31,605	.02	680
Sulu	12,000	1,600,000	.01	8,000
Surigao	250	4,250	.04	178
Tarlac	320	29,900	.04	1,051
Tayabas	10,598	238,516	.02	5,942
Zambales	1,014	87,842	.01	1,161
Zamboanga	18	200	.03	6
Philippine Islands	356,007	19,730,366	.01	267,197

Guanabano statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	3,009	63,784	₱0.05	₱2,990
Agusan	12,189	43,240	.05	2,247
Albay	21,880	176,488	.07	13,079
Antique	112,279	1,012,110	.02	20,442
Bataan	1,124	9,778	.07	707
Batanes				
Batangas	3,542	47,706	.02	1,157
Bohol	16,087	148,720	.03	4,653
Bukidnon	749	3,446	.05	172
Bulacan	1,095	9,558	.08	785
Cagayan	2,099	22,237	.05	1,054
Camarines Norte	780	5,545	.07	361
Camarines Sur	6,212	49,455	.04	1,739
Capiz	7,005	77,295	.03	2,072
Cavite	2,277	22,472	.06	1,298
Cebu	183,354	2,212,295	.05	101,883
Cotabato	1,843	21,448	.07	1,465
Davao	100	250	.07	18
Ilocos Norte	7,423	88,504	.02	1,427
Ilocos Sur	16,205	268,859	.02	5,361
Iloilo	6,510	218,283	.02	5,420
Isabela	1,183	33,670	.08	2,534
Laguna	1,230	22,005	.05	1,036
Lanao	62	498	.06	28
La Union	28,053	422,190	.04	17,636
Leyte	16,531	270,679	.04	10,220
Marinduque	6,470	61,434	.05	3,072
Masbate	6,160	40,260	.05	1,998
Mindoro	1,701	23,980	.06	1,450
Misamis	5,440	34,950	.03	1,178
Mountain	67	830	.10	83
Nueva Ecija	19,050	165,224	.03	4,218
Nueva Vizcaya	1,816	31,974	.03	852
Occidental Negros	22,058	365,192	.02	5,664
Oriental Negros	6,890	82,169	.02	1,715
Palawan	50			
Pampanga	9,439	85,540	.07	5,889
Pangasinan	16,611	488,514	.02	11,623
Rizal	2,488	10,636	.05	495
Romblon	949	18,503	.03	595
Samar	20,130	150,395	.06	8,741
Sorsogon	5,052	50,861	.05	2,500
Sulu				
Surigao	1,494	20,269	.05	1,009
Tarlac	2,527	157,372	.03	5,250
Tayabas	11,132	97,535	.05	4,749
Zambales	4,541	54,725	.06	3,448
Zamboanga	6,536	41,360	.02	797
Philippine Islands	603,422	7,232,238	.04	265,110

Orange statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	3,660	121,619	₱0.03	₱3,111
Agusan	744	35,800	.05	1,800
Albay	16,447	666,229	.01	7,056
Antique	231	9,030	.04	361
Bataan	305	2,040	.05	96
Batanes	242	14,300	.03	376
Batangas	22,223	711,988	.03	20,165
Bohol	5,227	182,536	.02	2,746
Bukidnon	527	16,700	.05	835
Bulacan	1,328	12,218	.04	428
Cagayan	9,636	875,861	.01	12,460
Camarines Norte	363	3,780	.04	150
Camarines Sur	5,342	220,379	.02	4,713
Capiz	1,966	113,800	.04	4,583
Cavite	800	141,600	.06	8,250
Cebu	8,434	457,571	.01	6,582
Cotabato	.....	.....	.....	.....
Davao	320	11,500	.05	575
Ilocos Norte	12,722	789,013	.04	27,835
Ilocos Sur	5,280	370,377	.06	22,439
Iloilo	17,542	361,498	.03	12,397
Isabela	7,017	362,400	.01	4,358
Laguna	2,003	43,480	.03	1,095
Lanao	987	69,350	.01	789
La Union	3,205	197,990	.02	3,944
Leyte	6,486	131,235	.02	2,988
Marinduque	4,990	78,600	.01	1,162
Masbate	140	9,950	.03	344
Mindoro	531	24,904	.02	563
Misamis	6,803	100,573	.02	2,202
Mountain	2,634	39,964	.02	666
Nueva Ecija	3,828	379,640	.03	12,846
Nueva Vizcaya	478	19,380	.02	460
Occidental Negros	11,089	596,264	.03	20,862
Oriental Negros	2,508	141,902	.01	1,745
Palawan	2,037	168,778	.01	1,612
Pampanga	963	81,618	.05	4,028
Pangasinan	15,101	401,299	.03	10,476
Rizal	1,028	29,410	.04	1,114
Romblon	588	24,900	.01	289
Samar	3,791	101,645	.01	1,279
Sorsogon	1,403	50,642	.01	711
Sulu	2,000	100,000	.01	1,000
Surigao	3,402	59,821	.02	1,370
Tarlac	1,770	113,100	.06	7,325
Tayabas	6,555	261,286	.03	7,444
Zambales	4,749	61,875	.03	2,131
Zamboanga	22	.....	.....	.....
Philippine Islands	209,447	8,767,845	.03	229,761

Ates statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	1,748	36,530	₱0.02	₱616
Agusan				
Albay	24,916	614,767	.01	7,356
Antique	6,815	21,690	.04	871
Bataan	10,499	160,119	.03	4,444
Batanes				
Batangas	59,518	1,157,928	.02	19,451
Bohol	7,381	41,726	.01	592
Bukidnon				
Bulacan	17,898	363,300	.06	20,388
Cagayan	7,962	138,275	.02	2,257
Camarines Norte	15,320	34,145	.02	795
Camarines Sur	8,748	92,229	.02	1,854
Capiz	13,909	52,370	.02	1,246
Cavite	14,079	259,000	.03	6,626
Cebu	564,392	7,526,539	.01	82,625
Cotabato	100	1,950	.01	19
Davao				
Ilocos Norte	21,317	273,311	.01	3,661
Ilocos Sur	20,748	249,850	.03	6,756
Iloilo	112,954	1,020,142	.01	11,980
Isabela	5,277	115,704	.01	1,155
Laguna	4,770	56,650	.02	1,361
Lanao				
La Union	8,199	121,023	.01	1,781
Leyte	9,345	134,531	.01	1,782
Marinduque	7,530	13,000	.01	130
Masbate	20,660	57,450	.03	1,493
Mindoro	7,531	84,537	.01	896
Misamis	1,943	37,465	.02	606
Mountain	5			
Nueva Ecija	67,624	354,749	.03	8,959
Nueva Vizcaya	822	14,144	.02	275
Occidental Negros	16,015	71,641	.01	862
Oriental Negros	25,774	385,327	.01	5,190
Palawan	1,940	16,500	.02	275
Pampanga	5,754	72,555	.04	2,674
Pangasinan	28,056	364,746	.01	4,728
Rizal	26,219	155,927	.03	4,372
Romblon	15,870	166,790	.01	2,389
Samar	2,831	28,770	.02	688
Sorsogon	6,942	71,800	.02	1,397
Sulu				
Surigao	24,319	704,352	.01	7,635
Tarlac	3,557	62,608	.03	1,680
Tayabas	15,957	139,080	.01	2,065
Zambales	8,767	125,485	.02	1,957
Zamboanga	475	1,808	.01	21
Philippine Islands	1,225,486	15,400,513	.01	225,908

Pomelo statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	190	1,100	₱0.05	₱60
Agusan	...	...	...	...
Albay	22,085	854,457	.03	22,649
Antique	397	9,180	.02	183
Bataan	2,665	49,177	.08	4,178
Batanes	...	...	...	...
Batangas	1,588	34,010	.06	1,993
Bohol	1,030	10,550	.03	313
Bukidnon	...	...	...	...
Bulacan	3,524	54,204	.10	5,399
Cagayan	3,101	62,070	.01	861
Camarines Norte	610	17,700	.03	469
Camarines Sur	36,371	975,550	.01	9,254
Capiz	1,076	35,480	.05	1,742
Cavite	2,448	59,670	.04	2,291
Cebu	7,461	129,769	.02	2,836
Cotabato	...	...	...	...
Davao	...	...	...	...
Ilocos Norte	5,078	54,398	.05	2,653
Ilocos Sur	4,412	79,480	.05	3,747
Iloilo	11,961	61,510	.03	1,958
Isabela	...	...	...	...
Laguna	2,445	35,662	.06	1,968
Lanao	75	1,600	.05	86
La Union	1,260	16,780	.04	588
Leyte	4,302	108,350	.01	1,370
Marinduque	3,190	59,800	.02	1,196
Masbate	1,128	5,208	.01	70
Mindoro	2,070	73,735	.03	2,488
Misamis	185	...	...	...
Mountain	1,008	27,360	.01	324
Nueva Ecija	12,984	130,630	.03	3,531
Nueva Vizcaya	819	25,660	.02	619
Occidental Negros	12,575	535,400	.01	5,711
Oriental Negros	12,416	188,268	.02	3,170
Palawan	...	...	...	...
Pampanga	1,612	81,070	.06	5,014
Pangasinan	10,997	64,883	.04	2,699
Rizal	3,748	55,469	.03	1,861
Romblon	1,458	139,000	.02	3,009
Samar	7,734	151,380	.03	5,262
Sorsogon	6,690	142,740	.01	1,346
Sulu	1,100	6,000	.03	180
Surigao	3,215	24,050	.01	249
Tarlac	1,534	6,230	.05	296
Tayabas	14,666	72,700	.01	872
Zambales	1,472	34,758	.09	3,161
Zamboanga	...	...	...	...
Philippine Islands	212,680	4,475,038	.02	105,656

Anonas statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per fruit	Total value
		Fruits		
Abra	3,427	40,970	₱0.02	₱725
Agusan	50	500	.03	15
Albay	9,257	94,871	.02	1,860
Antique	533	2,560	.01	26
Bataan	2,677	45,908	.03	1,470
Batanes	.....	.....	.....	.....
Batangas	5,608	84,942	.02	1,825
Bohol	322	8,150	.01	86
Bukidnon	.....	.....	.....	.....
Bulacan	3,845	44,700	.06	2,558
Cagayan	5,710	109,466	.02	2,265
Camarines Norte	209	9,970	.03	277
Camarines Sur	1,817	20,125	.01	267
Capiz	330	18,550	.02	371
Cavite	3,855	25,156	.02	427
Cebu	14,500	185,617	.01	2,738
Cotabato	.....	.....	.....	.....
Davao	.....	.....	.....	.....
Ilocos Norte	18,114	524,259	.01	4,597
Ilocos Sur	3,272	47,470	.02	931
Iloilo	12,009	125,793	.02	2,583
Isabela	1,639	27,926	.01	314
Laguna	9,741	129,771	.01	1,639
Lanao	3	42	.02	1
La Union	119,761	2,661,837	.01	26,997
Leyte	3,328	133,488	.01	1,881
Marinduque	1,000	10,050	.01	101
Masbate	2,692	20,040	.02	363
Mindoro	782	24,500	.02	371
Misamis	212	2,492	.02	60
Mountain	26	370	.02	7
Nueva Ecija	11,098	334,935	.02	6,535
Nueva Vizcaya	1,214	25,653	.01	296
Occidental Negros	1,896	49,528	.02	1,210
Oriental Negros	50,415	935,892	.01	9,359
Palawan	100	3,800	.01	38
Pampanga	14,120	440,630	.04	19,484
Pangasinan	36,476	312,125	.02	4,949
Rizal	1,118	13,570	.03	511
Romblon	520	9,000	.01	85
Samar	1,753	18,800	.01	216
Sorsogon	21,825	13,982	.03	387
Sulu	.....	.....	.....	.....
Surigao	1,325	4,785	.02	98
Tarlac	4,433	94,952	.02	2,249
Tayabas	1,266	54,410	.02	954
Zambales	3,841	45,813	.03	1,231
Zamboanga	.....	.....	.....	.....
Philippine Islands	376,119	6,757,398	.02	102,357

Chico statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Fruits		
Abra	80	2,500	₱0.01	₱25
Agusan				
Albay	328	7,300	.01	86
Antique	2	200	.01	2
Bataan	1,329	191,605	.02	3,624
Batanes				
Batangas	5,747	1,027,098	.009	9,541
Bohol	153	25,553	.01	249
Bukidnon				
Bulacan	2,821	641,306	.01	8,720
Cagayan	171	2,880	.02	45
Camarines Norte				
Camarines Sur	5			
Capiz	352	5,050	.005	26
Cavite	2,284	515,320	.009	4,612
Cebu	10,075	1,238,675	.01	14,239
Cotabato				
Davao				
Ilocos Norte	460	30,158	.01	405
Ilocos Sur	894	144,534	.01	1,706
Iloilo	591	13,170	.01	184
Isabela				
Laguna	8,014	1,310,813	.009	11,687
Lanao				
La Union	477	21,400	.01	213
Leyte	180	5,800	.01	70
Marinduque	4			
Masbate				
Mindoro	111	26,500	.02	505
Misamis	219	6,340	.01	75
Mountain				
Nueva Ecija	1,831	262,024	.01	2,777
Nueva Vizcaya	12			
Occidental Negros	3,582	199,484	.009	1,745
Oriental Negros	410	18,625	.02	298
Palawan				
Pampanga	1,735	558,200	.01	7,452
Pangasinan	4,177	183,269	.01	2,179
Rizal	2,457	131,815	.02	2,345
Romblon	200	6,000	.01	60
Samar	51	4,300	.01	45
Sorsogon	83	8,400	.02	168
Sulu				
Surigao	80			
Tarlac	24	5,270	.02	98
Tayabas	833	62,000	.008	480
Zambales	524	7,831	.01	92
Zamboanga				
Philippine Islands	50,296	6,663,420	.01	73,753

Castor bean statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra				
Agusan				
Albay	3,287	1,127	₱0.24	₱275
Antique	17,923	4,450	.55	2,460
Bataan	3,975	1,138	.18	210
Batanes				
Batangas	5,162			
Bohol	6,881	5,151	.38	1,963
Bukidnon				
Bulacan	220			
Cagayan	1,417			
Camarines	400			
Camarines Sur	830	1,200	.30	360
Capiz	15,667	2,063	.24	489
Cavite				
Cebu	290,528	57,970	.12	7,097
Cotabato	845	421	.16	67
Davao				
Ilocos Norte	109,852	25,985	.06	1,552
Ilocos Sur	3,903	2,419	.27	649
Iloilo	8,407	1,426	.13	180
Isabela	4,000	714	.60	427
Laguna				
Lanao				
La Union	43,242	2,733	.21	564
Leyte	12,999	2,193	.19	415
Marinduque	27,950	1,013	.30	305
Masbate				
Mindoro	1,305	573	.23	131
Misamis	375			
Mountain	510			
Nueva Ecija	35,775	10,850	.49	5,280
Nueva Vizcaya	9,929	5,633	.11	621
Occidental Negros	74,212	8,730	.14	1,251
Oriental Negros	246,898	19,437	.17	3,261
Palawan	23,500			
Pampanga	350			
Pangasinan	421,282	18,558	.13	2,323
Rizal	127			
Romblon	4,830	1,440	.28	396
Samar	1,680	148	.34	51
Sorsogon	2,260	1,033	.10	105
Sulu				
Surigao	1,000	1,783	.50	900
Tarlac	6,500	934	.13	124
Tayabas	3,050	1,103	.20	224
Zambales	2,759	2,202	.11	239
Zamboanga				
Philippine Islands	1,393,830	182,427	.17	31,919

Lumbang statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra	....	....	....	....
Agusan	....	....	....	....
Albay	....	....	....	....
Antique	1,369	629	₱0.82	₱518
Bataan	300	....	....	....
Batanes	....	....	....	....
Batangas	19,830	488,307	.31	150,401
Bohol	3,854	29,591	.29	8,606
Bukidnon	....	....	....	....
Bulacan	....	....	....	....
Cagayan	4,518	15,275	1.01	15,428
Camarines Norte	25	....	....	....
Camarines Sur	339	250	.50	125
Capiz	2,584	6,802	.80	5,442
Cavite	7,520	146,362	.15	21,679
Cebu	7,274	52,402	.17	9,037
Cotabato	....	....	....	....
Davao	....	....	....	....
Ilocos Norte	59	62	1.05	65
Ilocos Sur	1,062	1,790	.03	59
Iloilo	390	4,100	.70	2,890
Isabela	3,205	55,255	.07	3,863
Laguna	14,900	231,652	.11	25,674
Lanao	....	....	....	....
La Union	60	13	2.00	26
Leyte	30	50	.60	30
Marinduque	200	120	5.00	600
Masbate	4,100	85,300	.25	21,718
Mindoro	475	1,180	1.00	1,180
Misamis	....	....	....	....
Mountain	12	30	2.00	60
Nueva Ecija	1,251	2,490	1.00	2,470
Nueva Vizcaya	507	854	1.87	1,598
Occidental Negros	5,283	9,976	.78	7,800
Oriental Negros	1,520	23,993	2.73	65,428
Palawan	....	....	....	....
Pampanga	....	....	....	....
Pangasinan	6,180	4,721	.20	946
Rizal	1,614	2,288	1.00	2,288
Romblon	1,155	5,640	.15	868
Samar	....	....	....	....
Sorsogon	291	128	.50	64
Sulu	....	....	....	....
Surigao	....	....	....	....
Tarlac	17	14	1.00	14
Tayabas	3,863	9,052	.21	1,941
Zambales	83	....	....	....
Zamboanga	8,010	16,000	.30	4,800
Philippine Islands	101,880	1,194,326	.30	355,618

Kapok statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra	5,157	2,205	₱1.45	₱3,195
Agusan	6,814	365	.92	334
Albay	15,363	1,965	.90	1,776
Antique	11,073	1,723	.41	706
Bataan	15,615	8,752	1.56	13,679
Batanes	....	....	....	....
Batangas	59,467	22,720	.61	13,865
Bohol	6,272	2,567	.61	1,576
Bukidnon	4,793	1,872	.59	1,106
Bulacan	4,250	2,258	.60	1,346
Cagayan	35,336	25,976	1.00	25,933
Camarines Norte	83,419	6,845	.49	3,379
Camarines Sur	59,760	31,240	1.12	35,044
Capiz	25,563	8,967	.51	4,598
Cavite	3,560	2,335	.56	1,316
Cebu	164,622	72,462	.73	53,111
Cotabato	1,235	222	.89	197
Davao	1,500	58	.47	27
Ilocos Norte	92,728	20,176	.80	16,040
Ilocos Sur	84,048	18,371	1.23	22,650
Iloilo	47,806	17,620	.72	12,627
Isabela	1,090	2,522	.16	410
Laguna	2,242	71	2.10	149
Lanao	....	....	....	....
La Union	37,193	34,589	.50	17,304
Leyte	23,825	29,193	.38	11,095
Marinduque	3,200	41	1.12	46
Masbate	100	65	.46	30
Mindoro	11,328	1,327	.81	1,072
Misamis	4,450	3,387	.45	1,513
Mountain	416	299	1.11	331
Nueva Ecija	10,579	5,072	1.02	5,190
Nueva Vizcaya	7,163	3,664	.23	861
Occidental Negros	30,589	5,446	1.06	5,761
Oriental Negros	79,064	48,000	.38	18,400
Palawan	3,849	2,022	.35	708
Pampanga	9,480	1,869	1.13	2,104
Pangasinan	26,019	10,611	.70	7,458
Rizal	5,030	863	1.26	1,088
Romblon	5,752	2,893	.57	1,637
Samar	2,695	348	1.22	423
Sorsogon	2,663	1,125	.51	571
Sulu	....	....	....	....
Surigao	94	....	....	....
Tarlac	4,028	2,990	.97	2,909
Tayabas	54,121	10,226	1.02	10,452
Zambales	3,090	1,292	.95	1,226
Zamboanga	11,763	7,193	1.79	12,843
Philippine Islands	1,068,204	423,807	.75	316,086

Rubber statistics for the year ending June 30, 1921

Province	Trees cultivated	Production	Average price per kilo	Total value
		Kilos		
Abra	62			
Agusan	18			
Albay	260			
Antique	84			
Bataan				
Batanes				
Batangas				
Bohol	106			
Bukidnon	550			
Bulacan				
Cagayan	10			
Camarines Norte				
Camarines Sur	4			
Capiz				
Cavite				
Cebu	107			
Cotabato				
Davao	17,415			
Ilocos Norte				
Ilocos Sur				
Iloilo	50			
Isabela				
Laguna	46			
Lanao				
La Union	6			
Leyte				
Marinduque				
Masbate				
Mindoro	1,200			
Misamis	1,290			
Mountain				
Nueva Ecija				
Nueva Vizcaya	19			
Occidental Negros				
Oriental Negros	672			
Palawan				
Pampanga	2			
Pangasinan				
Rizal	44			
Romblon				
Samar				
Sorsogon	7,016			
Sulu				
Surigao	1			
Tarlac	15			
Tayabas	10			
Zambales				
Zamboanga	335,644	92,209	₱1.50	₱138,314
Philippine Islands	364,631	92,209	1.50	138,314

Carabaos, 1920

Province	Calves born during the year	Deaths from disease	Deaths from all other causes	Slaughtered	Number to Dec. 31	Average price per head	Total value to Dec. 31
Abra	5,058	83	375	631	32,012	₱121	₱3,857,632
Agusan	319	12	42	19	3,080	134	413,045
Albay	5,076	113	449	1,074	28,051	95	2,684,825
Antique	2,553	102	172	195	31,097	208	6,477,695
Bataan	1,043	407	70	192	11,302	165	1,870,185
Batanes	1	....	....	....	5	100	500
Batangas	1,997	413	146	108	16,104	117	1,886,553
Bohol	4,783	429	322	982	55,948	132	7,367,989
Bukidnon	518	15	26	45	3,102	147	455,520
Bulacan	4,599	1,909	222	1,654	47,255	188	8,885,486
Cagayan	11,270	621	518	924	69,734	144	10,066,225
Camarines Norte	562	30	24	17	7,510	118	886,775
Camarines Sur	4,128	533	340	205	27,050	126	3,398,543
Capiz	5,940	119	302	680	43,371	213	9,251,121
Cavite	1,465	82	99	170	17,753	172	3,047,695
Cebu	7,067	723	418	1,047	60,924	178	10,859,741
Cotabato	157	11	23	3	3,966	122	482,050
Davao	3,231	29	138	37	8,184	90	738,160
Ilocos Norte	8,960	10	166	1,146	58,547	168	9,783,132
Ilocos Sur	7,542	53	341	1,551	55,819	152	8,478,585
Iloilo	6,438	3,146	374	1,228	63,796	301	19,219,010
Isabela	5,001	74	201	626	38,982	209	8,163,160
Laguna	2,496	1,106	253	1,117	23,308	264	6,150,650
Lanao	504	218	67	42	3,483	221	769,170
La Union	3,577	62	296	1,050	43,137	148	6,389,480
Leyte	5,475	165	483	933	50,424	156	7,865,345
Manila, City of	19	115	....	8	1,792	222	397,824
Marinduque	2,644	....	187	75	8,454	124	1,050,770
Masbate	3,335	70	119	83	17,101	169	2,902,250
Mindoro	4,721	127	394	33	12,707	134	1,705,540
Misamis	2,606	274	152	506	22,742	159	3,622,050
Mountain	3,774	107	1,401	589	20,408	137	2,809,155
Nueva Ecija	6,370	267	206	678	72,647	176	12,820,099
Nueva Vizcaya	2,019	2	46	41	12,723	270	3,437,225
Occidental Negros	4,471	2,303	451	715	61,865	334	20,690,750
Oriental Negros	1,622	1,122	194	321	20,698	179	3,708,900
Palawan	977	83	140	11	7,641	157	1,200,330
Pampanga	3,020	349	159	773	50,014	230	11,513,080
Pangasinan	20,517	170	219	2,861	120,777	180	21,771,170
Rizal	2,288	2,186	58	323	20,001	219	4,381,850
Romblon	1,429	70	116	118	10,696	155	1,657,935
Samar	4,336	295	202	488	24,997	185	4,631,863
Sorsogon	2,043	38	320	187	11,598	135	1,571,470
Sulu	67	....	....	....	1,741	89	155,512
Surigao	4,613	79	267	955	27,572	105	2,904,185
Tarlac	6,955	345	173	1,254	48,496	204	9,906,332
Tayabas	6,262	1,130	160	712	38,150	165	6,304,265
Zambales	4,354	101	151	335	30,087	180	5,405,900
Zamboanga	5,414	832	319	184	17,434	125	2,180,350
Philippine Islands	193,616	20,530	11,301	26,926	1,464,285	182	266,177,077

Cattle, 1920

Province	Calves born during the year	Deaths from disease	Deaths from all other causes	Slaughtered	Number to Dec. 31	Average price per head	Total value to Dec. 31
Abra	3,691	39	347	404	15,771	₱100	₱1,577,847
Agusan	295	7	1	99	922	85	78,325
Albay	1,613	98	189	832	5,636	84	471,346
Antique	5,497	37	222	835	45,220	82	3,700,052
Bataan	626	4	16	92	1,865	112	209,670
Batanes	1,916	56	405	324	14,588	43	628,955
Batangas	11,046	1,527	416	5,275	72,737	128	9,336,823
Bohol	8,475	595	338	1,989	30,353	54	1,646,305
Bukidnon	1,338	150	10	463	13,108	83	1,093,902
Bulacan	1,015	392	41	865	4,944	101	497,383
Cagayan	2,772	11	314	841	5,797	112	648,721
Camarines Norte	232	10	12	241	1,419	93	131,356
Camarines Sur	1,670	13	67	508	4,556	94	427,136
Capiz	5,724	219	552	676	10,598	86	914,256
Cavite	1,946	29	129	1,924	12,481	127	1,587,811
Cebu	8,057	1,011	243	2,554	37,912	66	2,506,735
Cotabato	602	....	54	66	4,577	47	215,491
Davao	3,453	55	201	2,175	18,841	83	1,572,459
Ilocos Norte	6,069	1	52	963	18,365	124	2,872,207
Ilocos Sur	6,688	20	241	1,203	33,248	110	3,673,824
Iloilo	11,127	1,198	347	3,953	49,569	152	7,527,700
Isabela	1,667	17	27	447	5,245	129	677,040
Laguna	2,186	47	85	2,518	7,444	151	1,124,561
Lanao	1,820	189	126	310	7,141	105	747,631
La Union	1,627	29	138	591	11,779	99	1,171,523
Leyte	5,880	10	370	1,344	27,287	64	1,765,693
Manila, City of	35	[a] 132	....	25,781	2,779	91	252,889
Marinduque	7,564	54	741	853	19,787	57	1,128,635
Masbate	8,407	....	146	767	33,670	61	2,066,537
Mindoro	9,738	92	653	805	22,532	65	1,468,669
Misamis	1,385	43	89	880	4,444	89	398,539
Mountain	6,167	....	2,946	959	26,972	75	2,027,985
Nueva Ecija	1,403	4	52	720	7,338	100	734,951
Nueva Vizcaya	1,072	3	40	186	4,997	135	676,926
Occidental Negros	3,416	921	301	1,825	22,265	214	4,764,775
Oriental Negros	1,571	694	154	783	15,091	94	1,425,557
Palawan	3,986	231	238	1,032	17,792	32	564,024
Pampanga	264	2	25	311	1,682	94	157,319
Pangasinan	5,509	20	51	1,729	20,960	122	2,560,894
Rizal	872	65	38	430	3,446	121	416,194
Romblon	3,547	86	464	881	15,609	42	658,068
Samar	1,688	26	120	664	6,700	101	677,278
Sorsogon	1,164	13	75	357	4,415	80	351,970
Sulu	441	....	....	68	3,744	38	142,600
Surigao	616	5	42	146	3,343	70	235,291
Tarlac	1,111	18	22	221	1,610	109	175,553
Tayabas	5,868	1,781	249	4,435	28,855	81	2,335,935
Zambales	3,519	96	73	402	12,977	97	1,254,831
Zamboanga	6,692	1,269	320	440	18,509	103	1,914,510
Philippine Islands	173,067	11,319	11,782	76,167	760,920	96	73,194,682

[a] Sixty showed evidence of disease when killed.

Horses and mules, 1920

Province	Colts born during the year	Deaths from diseases	Deaths from all other causes	Slaughtered
Abra	2,347	55	322	40
Agusan	352	....	1	3
Albay	1,032	112	226	150
Antique	86	8	6	....
Bataan	34	27	3	22
Batanes	2	....	....	....
Batangas	4,999	73	82	53
Bohol	1,333	183	161	31
Bukidnon	711	14	3	3
Bulacan	1,150	71	42	132
Cagayan	1,961	565	226	1
Camarines Norte	1	....	....	....
Camarines Sur	127	68	23	1
Capiz	363	32	61	15
Cavite	2,210	66	162	101
Cebu	2,699	65	153	159
Cotabato	40	11	7	....
Davao	315	20	75	....
Ilocos Norte	2,991	14	74	1,001
Ilocos Sur	2,318	13	150	44
Iloilo	236	38	36	19
Isabela	1,339	127	22	1
Laguna	1,765	154	130	109
Lanao	173	9	19	4
La Union	813	6	31	15
Leyte	1,627	106	172	187
Manila, city of	188	280	....	....
Marinduque	1,406	6	73	15
Masbate	520	18	59	....
Mindoro	1,576	36	226	....
Misamis	1,236	57	115	78
Mountain	1,159	65	520	54
Nueva Ecija	753	80	22	13
Nueva Vizcaya	414	25	64	3
Occidental Negros	413	76	93	8
Oriental Negros	1,363	95	142	93
Palawan	55	24	13	2
Pampanga	589	166	45	122
Pangasinan	3,195	34	71	32
Rizal	372	3	174	418
Romblon	599	5	79	11
Samar	175	425	35	3
Sorsogon	58	24	14	....
Sulu	101	6	....	....
Surigao	1,072	41	133	135
Tarlac	737	38	13	34
Tayabas	1,502	149	90	....
Zambales	1,484	39	47	4
Zamboanga	1,598	356	122	....
Philippine Islands	51,589	3,885	4,337	3,116

Horses and mules, 1920—Continued

Province	Number to December 31	Average price per head	Total value to December 31
Abra	9,969	₱163	₱1,623,556
Agusan	396	70	27,843
Albay	2,528	45	114,617
Antique	656	98	64,242
Bataan	341	142	48,585
Batanes	34	57	1,940
Batangas	34,221	116	3,974,359
Bohol	5,200	61	319,660
Bukidnon	3,457	87	299,385
Bulacan	6,526	157	1,026,880
Cagayan	7,920	162	1,283,905
Camarines Norte	60	121	7,240
Camarines Sur	378	68	25,710
Capiz	548	85	46,665
Cavite	15,781	115	1,810,165
Cebu	17,848	92	1,635,292
Cotabato	723	90	65,403
Davao	3,431	115	393,646
Ilocos Norte	13,709	131	1,795,291
Ilocos Sur	7,946	149	1,184,231
Iloilo	1,862	175	326,276
Isabela	6,565	186	1,223,080
Laguna	9,906	140	1,389,848
Lanao	1,057	113	119,395
La Union	3,739	108	405,421
Leyte	8,081	62	507,382
Manila, city of	10,888	141	1,535,208
Marinduque	4,593	63	291,430
Masbate	4,101	66	268,725
Mindoro	3,207	96	310,413
Misamis	4,276	86	369,305
Mountain	4,904	94	461,551
Nueva Ecija	4,558	98	447,599
Nueva Vizcaya	1,247	200	249,892
Occidental Negros	2,770	172	476,170
Oriental Negros	10,610	94	999,213
Palawan	285	64	18,250
Pampanga	5,339	128	684,088
Pangasinan	11,295	124	1,405,501
Rizal	4,446	137	611,088
Romblon	2,326	46	106,636
Samar	934	73	68,702
Sorsogon	189	73	13,959
Sulu	536	49	26,300
Surigao	5,517	56	307,396
Tarlac	1,806	150	270,495
Tayabas	14,032	114	1,595,606
Zambales	4,518	160	722,340
Zamboanga	3,740	60	223,670
Philippine Islands	268,999	116	31,183,554

Hogs, 1920

Province	Farrowed during the year	Deaths from disease	Deaths from all other causes	Slaughtered
Abra	14,899	2,005	2,633	5,611
Agusan	8,232	1,730	408	3,883
Albay	13,314	1,887	1,343	8,618
Antique	7,643	420	389	5,145
Bataan	9,765	264	228	5,522
Batanes	1,024	110	114	402
Batangas	66,237	8,187	1,023	14,188
Bohol	40,991	3,642	748	15,427
Bukidnon	1,202	10	5	527
Bulacan	17,277	1,291	1,136	13,453
Cagayan	28,490	4,610	1,917	13,556
Camarines Norte	1,346	89	78	1,234
Camarines Sur	8,151	715	630	10,723
Capiz	29,463	1,045	1,158	8,852
Cavite	10,831	1,223	197	8,194
Cebu	75,518	23,232	2,228	41,839
Cotabato	255	33	....	157
Davao	4,234	210	184	989
Ilocos Norte	21,825	167	404	12,007
Ilocos Sur	40,061	2,368	2,032	20,579
Iloilo	30,386	6,887	1,062	24,174
Isabela	10,024	2,318	254	4,081
Laguna	14,912	1,744	345	11,458
Lanao	362	10	85	181
La Union	15,140	173	731	7,900
Leyte	34,333	3,909	2,248	17,674
Manila, city of	656	[1] 1,302	....	108,362
Marinduque	3,916	51	214	1,586
Masbate	5,857	1,617	163	1,909
Mindoro	10,798	30	237	2,380
Misamis	26,383	5,415	711	8,198
Mountain	44,327	1,169	3,125	17,660
Nueva Ecija	16,860	6,483	816	11,513
Nueva Vizcaya	2,670	2,048	14	1,997
Occidental Negros	14,980	532	337	10,144
Oriental Negros	18,322	7,373	1,113	10,309
Palawan	35,817	235	151	1,408
Pampanga	30,770	5,861	1,498	15,900
Pangasinan	92,356	6,647	2,353	27,756
Rizal	16,401	2,178	845	18,240
Romblon	6,768	289	419	7,037
Samar	33,130	2,043	1,288	10,678
Sorsogon	6,201	318	680	4,116
Sulu	108	....	....	157
Surigao	12,717	1,746	997	6,283
Tarlac	25,691	3,772	575	18,642
Tayabas	17,726	1,553	515	10,501
Zambales	9,787	554	997	3,160
Zamboanga	7,757	338	265	1,674
Philippine Islands	945,913	119,833	38,893	555,984

[1] The meat of 1,300 was found to be diseased after the animals were killed.

Hogs, 1920—Continued

Province	Number to December 31	Average price per head	Total value to December 31
Abra	39,045	₱0.18	₱689,724
Agusan	24,368	26	621,398
Albay	76,476	21	1,627,067
Antique	62,340	17	1,036,643
Bataan	14,346	33	479,921
Batanes	3,652	9	32,298
Batangas	184,655	27	5,023,184
Bohol	158,981	24	3,832,285
Bukidnon	4,291	27	113,793
Bulacan	49,866	34	1,701,378
Cagayan	100,169	39	3,860,609
Camarines Norte	6,849	21	144,591
Camarines Sur	36,649	24	866,114
Capiz	73,314	24	1,774,414
Cavite	60,124	31	1,872,466
Cebu	384,693	28	10,818,227
Cotabato	1,109	23	25,307
Davao	25,539	37	969,149
Ilocos Norte	72,444	27	1,945,188
Ilocos Sur	90,822	27	2,476,521
Iloilo	127,307	24	3,105,766
Isabela	46,417	41	1,880,411
Laguna	35,953	28	1,021,572
Lanao	952	28	27,101
La Union	61,293	19	1,184,148
Leyte	114,173	26	2,960,073
Manila, city of	35,365	28	990,220
Marinduque	11,768	21	251,567
Masbate	15,020	23	348,196
Mindoro	22,822	28	634,183
Misamis	67,636	26	1,791,991
Mountain	226,767	17	3,828,635
Nueva Ecija	142,963	29	4,097,662
Nueva Vizcaya	11,417	33	382,652
Occidental Negros	94,485	28	2,679,221
Oriental Negros	78,555	28	2,162,174
Palawan	68,829	7	484,784
Pampanga	92,295	40	3,688,801
Pangasinan	333,155	27	8,932,796
Rizal	43,673	25	1,098,719
Romblon	34,258	25	852,196
Samar	96,403	30	2,899,028
Sorsogon	24,229	26	631,042
Sulu	474	41	19,440
Surigao	61,103	22	1,336,420
Tarlac	182,221	28	5,119,972
Tayabas	65,615	27	1,804,369
Zambales	32,884	27	872,806
Zamboanga	41,419	13	522,921
Philippine Islands	3,639,183	26	95,519,143

Goats, 1920

Province	Kids born during the year	Deaths from disease	Deaths from all other causes	Slaughtered
Abra	1,621	186	438	1,035
Agusan	4,474	15	7	580
Albay	5,771	615	980	2,263
Antique	1,996	54	91	698
Bataan	626	....	17	445
Batanes	306	3	12	141
Batangas	3,698	204	196	1,385
Bohol	5,615	280	350	1,527
Bukidnon	262	....	....	71
Bulacan	2,845	71	202	1,198
Cagayan	3,592	161	348	1,355
Camarines Norte	483	5	36	380
Camarines Sur	5,304	313	439	1,967
Capiz	14,605	964	859	3,999
Cavite	664	30	68	249
Cebu	9,230	1,544	759	5,796
Cotabato	81	3	1	48
Davao	197	12	92	75
Ilocos Norte	5,706	53	202	2,227
Ilocos Sur	6,711	98	555	3,089
Iloilo	9,504	1,314	648	5,179
Isabela	1,274	158	68	549
Laguna	972	54	65	367
Lanao	620	5	33	125
La Union	5,246	6	408	2,809
Leyte	8,250	297	986	3,395
Manila, city of	18	....	....	1,476
Marinduque	703	1	90	93
Masbate	1,319	118	139	327
Mindoro	1,167	15	88	178
Misamis	6,327	576	889	1,740
Mountain	767	23	319	312
Nueva Ecija	4,980	325	336	1,770
Nueva Vizcaya	374	2	26	226
Occidental Negros	4,865	263	378	2,143
Oriental Negros	5,094	246	373	2,762
Palawan	187	96	24	57
Pampanga	5,215	912	266	3,314
Pangasinan	14,335	445	529	4,200
Rizal	1,162	25	63	736
Romblon	2,116	208	384	2,727
Samar	6,303	869	404	3,190
Sorsogon	2,261	150	213	940
Sulu	110	....	....	29
Surigao	3,271	134	218	903
Tarlac	4,957	468	204	2,386
Tayabas	1,303	32	191	635
Zambales	2,250	24	180	656
Zamboanga	1,731	178	102	256
Philippine Islands	170,468	11,555	13,276	72,008

Goats, 1920—Continued

Province	Number to December 31	Average price per head	Total value to December 31
Abra	8,595	₱5	₱39,424
Agusan	17,399	14	237,765
Albay	19,676	5	89,612
Antique	16,398	3	51,956
Bataan	2,606	6	15,572
Batanes	1,880	5	8,464
Batangas	22,081	4	97,406
Bohol	28,695	5	134,210
Bukidnon	755	8	5,741
Bulacan	12,209	9	113,528
Cagayan	18,314	7	133,644
Camarines Norte	3,224	5	14,954
Camarines Sur	20,893	4	93,587
Capiz	46,388	5	233,451
Cavite	4,487	12	55,499
Cebu	58,927	4	228,853
Cotabato	609	5	3,043
Davao	1,328	9	12,009
Ilocos Norte	21,040	6	117,961
Ilocos Sur	28,304	6	167,402
Iloilo	47,548	5	231,133
Isabela	9,796	11	110,231
Laguna	5,292	10	54,321
Lanao	1,492	5	6,822
La Union	32,043	6	199,127
Leyte	41,495	7	277,859
Manila, city of	1,130	8	8,475
Marinduque	4,026	4	14,558
Masbate	4,326	4	15,746
Mindoro	4,993	4	20,196
Misamis	15,042	8	115,678
Mountain	1,836	6	11,687
Nueva Ecija	21,614	7	148,254
Nueva Vizcaya	3,087	7	21,271
Occidental Negros	42,572	5	210,081
Oriental Negros	28,446	5	148,356
Palawan	467	8	3,778
Pampanga	28,095	8	230,871
Pangasinan	58,537	7	416,300
Rizal	4,305	6	26,756
Romblon	20,723	3	72,125
Samar	18,980	7	135,758
Sorsogon	19,036	5	87,414
Sulu	1,243	7	8,535
Surigao	12,979	10	133,561
Tarlac	33,018	8	258,212
Tayabas	9,481	7	70,521
Zambales	6,652	8	53,600
Zamboanga	9,599	8	78,728
Philippine Islands	821,661	6	5,024,035

Sheep, 1920

Province	Lambs born during the year	Deaths from diseases	Deaths from all other causes	Slaughtered
Abra	789	59	290	412
Agusan	163	6	1	87
Albay	443	159	224	360
Antique	290	....	9	91
Bataan	75	....	9	60
Batanes	74	....	8	27
Batangas	45	25	15	26
Bohol	757	134	62	116
Bukidnon	75	....	....	....
Bulacan	511	7	1	330
Cagayan	1,793	52	110	497
Camarines Norte	2	....	....	2
Camarines Sur	808	47	68	149
Capiz	1,521	162	171	494
Cavite	57	1	34	31
Cebu	2,054	928	421	806
Cotabato	1	....	....	....
Davao	116	....	15	4
Ilocos Norte	4,609	99	211	1,951
Ilocos Sur	3,857	54	499	1,497
Iloilo	2,227	235	282	1,282
Isabela	1,155	52	34	267
Laguna	118	7	8	49
Lanao	4	....	....	....
La Union	1,150	9	85	391
Leyte	2,688	77	314	1,183
Manila, city of	9	....	....	65
Marinduque	....	....	....	....
Masbate	106	12	25	30
Mindoro	271	....	2	8
Misamis	2,194	201	174	371
Mountain	555	35	195	236
Nueva Ecija	1,128	120	235	293
Nueva Vizcaya	53	7	14	21
Occidental Negros	3,981	199	190	1,723
Oriental Negros	1,701	68	175	594
Palawan	....	....	....	....
Pampanga	6,176	328	80	949
Pangasinan	3,654	49	67	1,042
Rizal	307	1	16	331
Romblon	73	2	2	58
Samar	444	21	45	220
Sorsogon	379	16	53	94
Sulu	4	....	....	1
Surigao	477	1	32	232
Tarlac	1,114	53	20	348
Tayabas	13	....	....	3
Zambales	1,096	15	143	436
Zamboanga	207	4	17	20
Philippine Islands	49,324	3,245	4,356	17,187

Sheep, 1920—Continued

Province	Number to December 31	Average price per head	Total value to December 31
Abra	2,587	₱4	₱11,180
Agusan	381	7	2,712
Albay	2,012	10	20,438
Antique	2,004	7	14,173
Bataan	216	8	1,779
Batanes	413	5	1,883
Batangas	207	11	2,185
Bohol	2,098	6	13,586
Bukidnon	349	8	2,786
Bulacan	1,378	12	17,195
Cagayan	7,977	8	64,900
Camarines Norte	51	10	510
Camarines Sur	3,731	12	44,070
Capiz	3,232	8	26,201
Cavite	288	7	2,019
Cebu	10,818	6	67,575
Cotabato	19	10	190
Davao	532	13	7,129
Ilocos Norte	13,583	6	82,805
Ilocos Sur	11,217	7	79,001
Iloilo	14,929	6	92,119
Isabela	4,325	9	37,469
Laguna	683	14	9,630
Lanao	9	7	61
La Union	6,930	7	51,708
Leyte	13,816	9	120,231
Manila, city of	423	10	4,230
Marinduque	10	8	80
Masbate	475	8	3,747
Mindoro	485	8	4,042
Misamis	4,062	9	38,577
Mountain	1,142	8	9,299
Nueva Ecija	3,185	9	29,549
Nueva Vizcaya	96	11	1,070
Occidental Negros	29,748	6	177,407
Oriental Negros	8,366	7	57,388
Palawan	....	....	....
Pampanga	13,904	9	128,084
Pangasinan	11,678	10	112,684
Rizal	1,011	9	9,522
Romblon	330	8	2,734
Samar	1,755	10	16,802
Sorsogon	1,093	8	8,783
Sulu	20	6	120
Surigao	859	8	6,919
Tarlac	9,585	8	79,563
Tayabas	71	3	213
Zambales	2,895	7	19,413
Zamboanga	727	8	6,146
Philippine Islands	195,705	8	1,489,907

A PROVISIONAL LIST OF THE PARASITIC FUNGI OF THE PHILIPPINE ISLANDS

By Colin G. Welles

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The first list of Philippine fungi was published in 1906 in the *Philippine Journal of Science* by Ricker. This list was very brief, containing but 32 genera and 45 species. In 1914, eight years later, C. F. Baker published *The lower fungi of the Philippine Islands* in the *Philippine Leaflets of Botany*. This work greatly enlarged the list of fungi already known and contained no less than 215 genera and 638 species. The following year, 1915, Baker published a second list in the *Philippine Leaflets of Botany*, the *First supplementary list to the lower fungi of the Philippine Islands*. This supplement added 320 fungi not included in the first list. Hence the total number of fungus forms known at the end of 1915 was about 958.

No comprehensive lists have been published since Baker's in 1915 and the mass of material has increased unbelievably. However, Yates in 1919 compiled a *Host index of Philippine fungi* which has never been published.

The present paper is confined to parasitic fungi, therefore excluding great numbers of saprophytes. A comparison of the present number of fungi listed with those known in 1915 means very little because of this fact. However, in the following list about 260 genera and 958 species are represented.

The present classification of fungi is being altered continually so even the approximate position of a fungus is frequently but temporary. There may be duplications of species but it is hoped that this is infrequent.

The material for this list has been taken mainly from the *Baker Mycological Collection* in the Department of Plant Pathology, College of Agriculture, Los Baños. However, all available publications have been perused in order to make the present list as complete as possible. And lastly, the entire number was checked over with Yates' unpublished manuscript making possible the addition of many species not found elsewhere.

PHYCOMYCETES

CHYTRIDALES

SYNCHYTRIACEAE

WORONINELLA DOLICHI (Cke.) Syd.
On *Dolichos lablab.*
WORONINELLA PSOPHOCARPI Rac.
On *Psophocarpus tetragonolobus.*
WORONINELLA PUERARIAE (P. Henn.) Syd.
On *Pueraria thunbergiana.*

SAPROLEGNIALES

PYTHIACEAE

PYTHIUM DEBARYANUM Hesse.
On *Cucumis sativus.*
Lycopersicum esculentum.
Nicotiana tabacum.

PERONOSPORALES

PERONOSPORACEAE

BREMIA LACTUCAE Reg.
On *Lactuca sativa.*
PERONOSPORA TRIFOLIORUM de Bary.
On *Glycine max.*
PHYTOPHTHORA COLOCASIAE Rac.
On *Colocasia esculentum.*
PHYTOPHTHORA FABERI Maubl.
On *Cocos nucifera.*
Hevea braziliensis.
Young fruits of *Theobroma cacao.*
Carica papaya.
PHYTOPHTHORA INFESTANS (Mont.) de Bary.
On *Solanum tuberosum.*
PHYTOPHTHORA NICOTIANAE Breda
On *Nicotiana tabacum.*
PLASMOPARA CUBENSIS (B. & C.) Humphrey (PSEUDOPERONOSPORA)
On *Cucumis sativus.*
Curcurbita maxima.
Luffa cylindrica.
Momordica charantia.
SCLEROSPORA PHILIPPINENSIS Weston.
On *Zea mays.*
SCLEROSPORA SACCHARI Miyabe.
On *Saccharum officinarum.*

MUCORACEAE

RHIZOPUS ARTOCARPI Rac.
On *Artocarpus integrifolia.*

ASCOMYCETES

PERISPORIALES

ERYSIPHACEAE

PHYLLACTINIA CORYLEA (Pers.) Kast.
On *Morus alba.*
PHYLLACTINIA SUFFULTA (Rebent.) Sacc.
On *Morus alba.*

PERISPORIACEAE

AMAZONIA ACALYPHAE (Rehm.) Theiss.
On *Acalypha stipulacea.*
AMAZONIA PEREGRINA Syd.
On *Maesa elmeri.*
Maesa laxa.
DIMERINA GRAFFII Syd.
On *Meliola* on *Gmelina philippinensis.*
DIMERINA GRAFFII Syd.
On *Mallotus* sp.
DIMERIUM PSEUDOPERISPORIOIDES Rehm.
On *Ipomoea* sp.
DIMERIUM RIZALENSE Syd.
On *Asterina pusilla* Syd. on *Premna* sp.
DIMERIUM TAYABENSIS Yates.
On *Momordica charantia.*
DIMEROSPORINA DINOCHLOAE Syd.
On *Dinochloa scandens.*
DIMEROSPORINA PUSILLA Syd.
On *Lophatherum gracile.*
DIMEROSPORIUM LUSSONIENSE Sacc.
On *Pittosporum* sp.

EPIPHYMA MUCUNAE (Rac.) Syd.
On *Mucuna* sp.
Spatholobus gyrocarpus.

EPIPHYMA PREMNAE Syd.
On *Premna cumingiana.*

EUROTIUM REPENS de Bary.
On *Antidesma ghesaembilla.*

IRENE ANISOMERA Syd.
On *Podocarpus costata.*

IRENE CONFRAGOSA Syd.
On *Cucurbita* sp.
Luffa cylindrica.
Trichosanthes quinquangulata.

IRENE PAPILLIFERA Syd.
On *Saurauia elegans.*

IRENE VILIS Syd.
On *Callicarpa* sp.
Callicarpa blancoi.

MELIOLA ABRUPTA Syd.
On *Derris diadelpha.*

MELIOLA ACALYPHAE Rehm.
On *Acalypha stipulacea.*

MELIOLA ACICULOSA Wint. var. VITICIS Rehm.
On *Vitex negundo.*

MELIOLA ACUTISECTA Syd.
On *Persea pyriformis.*

MELIOLA AFFINIS Syd.
On *Memecylon* sp.

MELIOLA AGLAIAE Syd.
On *Aglaia* sp.

MELIOLA ALANGIAE Syd.
On *Alangium begoniaefolium*

MELIOLA ALSTONIAE Koord.
On *Alstonia macrophylla.*

MELIOLA AMOORAE Yates.
On *Amoora* sp.

MELIOLA AMPHITRICHA Fr.
On *Pithecolobium apoense.*
Viburnum odoratissimum.

MELIOLA ANACARDII Zimm.
On *Macaranga tanarius.*

MELIOLA APAYAOENSIS Yates.
On *Macaranga tanarius.*

MELIOLA ARACHNOIDEA Speg.
On *Triumfetta bartramia.*

MELIOLA ARANEOSA Syd.
On *Gouania microcarpa.*

MELIOLA ARTOCARPIAE Yates.
On *Artocarpus* sp.

MELIOLA ARUNDINIS Pat.
On *Phragmites vulgaris.*
Saccharum officinarum.

MELIOLA BAKERI Syd.
On *Tetrastigma* sp.

MELIOLA BANAHAENSIS Yates.
On *Dysoxylum* sp.

MELIOLA BANOSENSIS Syd.
On *Pueraria phaseoloides.*

MELIOLA BAGUIENSIS Yates.
On one of the *Menispermaceae.*

MELIOLA BARRINGTONIAE Yates.
On *Barringtonia luzonensis.*

MELIOLA BASILANENSIS Yates.
On *Macaranga tanarius.*

MELIOLA BATAANENSIS Syd.
On *Millettia sp.*

MELIOLA BAUHINIAE Yates.
On *Bauhinia* sp.

MELIOLA BIDENTATA Cooke.
On *Litsea perrottetii.*

MELIOLA BOERLAGIODENDRIAE Yates.
On *Boerlagiodendron* sp.

MELIOLA CADIGENSIS Yates.
On *Glycosmis cochinchinensis.*

MELIOLA CALLICARPAE Syd.
On *Callicarpa cana.*

MELIOLA CALLISTA Rehm.
On *Premna cumingiana.*
Premna nauseosa.
Premna odorata.

MELIOLA CANARII Syd.
On *Canarium* sp.
Canarium villosum.

MELIOLA CATUGIGENSIS Yates.
On *Loranthus* sp.

MELIOLA CAVITENSIS Yates.
On *Coleus* sp.

MELIOLA CELTICOLA Yates.
On *Celtis philippinensis.*

MELIOLA CELTIDIAE Yates.
On *Celtis* sp.

MELIOLA CHAMPEREIAE Syd.
On *Champereia* sp.
Champereia manillana.

MELIOLA CITRICOLA Syd.
On *Citrus maxima.*

MELIOLA CLERODENDRICOLA P. Henn.
On *Clerodendron* sp.
Clerodendron minahasse.

MELIOLA CONNARI Yates.
On *Connarus* sp.

MELIOLA COOKEANA Speg. v. SACCHARDOI Syd.
On *Litsea glutinosa*
Litsea perrottetii

MELIOLA CYLINDROPHORA Rehm.
On *Guioa perrottetii.*
Itea sp.
Itea meseaefolia.
Nephelium mutabile.
Premna cumingiana.

MELIOLA DEPRESSULA Syd.
On *Urceola imberbis.*

MELIOLA DERRIDIS Yates.
On *Derris* sp.

MELIOLA DESMODII Karst. and Roun.
On *Desmodium gangeticum.*
Desmodium virgatum.

MELIOLA DICHOTOMA Berk. and Cke.
On *Phragmites* sp.
Phragmites karka.

MELIOLA DIOSPYRIAE Yates.
On *Diospyros discolor.*

MELIOLA DIPLOCHAETA Syd.
On *Taluama villariana.*

MELIOLA ELAEOCARPEAE Yates.
On *Elaeocarpus* sp.

MELIOLA ELMERI Syd.
On *Pittosporum pentandrum.*

MELIOLA ERYTHRINAE Syd.
On *Erythrina indica.*

MELIOLA EXOCARPIAE Syd.
On *Exocarpus latifolius.*

MELIOLA FAGRAEAE Syd.
On *Fagraea plumeriaefolia.*

MELIOLA FORBESII Gaill.
On *Merremia umbellata.*

MELIOLA GARCINIAE Yates.
On *Garcinia* sp.

MELIOLA GLIRICIDIAE Syd.
On *Gliricidia sepium.*

MELIOLA GYMNOSPORAE Syd.
On *Gymnospora spinosa.*

MELIOLA HAMATA Syd.
On *Buchanania arborescens.*
Buchanania nitida.

MELIOLA HETEROCEPHALA Syd.
On *Desmodium sp.*
Desmodium laxiflorum.
Desmodium pulchellum.

MELIOLA HETERODONTA Syd.
On *Dracontomelum* sp.

MELIOLA HETEROTRICHA Syd.
On *Donax cannaeformis.*

MELIOLA HEWITTIAE Rehm.
On *Hewittia sublobata.*

MELIOLA HOPEAE Yates.
On *Hopea* sp.

MELIOLA HOYAE Syd.
On *Hoya luzonensis.*

MELIOLA HYPTIDIS Syd.
On *Hyptis suaveolens.*

MELIOLA IMPERATAE Syd.
On *Imperata cylindrica.*

MELIOLA INSIGNIS Gaill.
On *Mallotus philippinensis.*

MELIOLA INTRICATA Syd.
On *Scirpus grossus.*

MELIOLA IPOMOEAE Rehm.
On *Merremia* sp.

MELIOLA IXORIAE Yates.
On *Ixora philippinensis.*

MELIOLA JASMINICOLA P. Henn.
On *Jasminum sambac.*

MELIOLA LAEVIGATA Syd.
On *Paralstonia clusiacea.*

MELIOLA LEPISANTHEA Sacc.
On *Lepisanthes schizolepis.*

MELIOLA LEPTOCHAETA Syd.
On *Vavaea* sp.

MELIOLA LEUCOSYKEAE Yates.
On *Leucosyke capitellata.*

MELIOLA LINOCIERAE Syd.
On *Linociera ramiflora.*

MELIOLA LITSEA Yates.
On *Litsea* sp.
Litsea perrottetii.

MELIOLA LIVISTONIAE Yates.
On *Livistona* sp.

MELIOLA LUZONENSIS Syd.
On *Antidesma* sp.

MELIOLA MACARANGAE Syd.
On *Macaranga sp.*
Macaranga bicolor.
Macaranga tanarius.

MELIOLA MACHROCHAETA Syd.
On *Alsodeia formicaria.*

MELIOLA MAESAE Rehm.
On *Maesa laxa.*

MELIOLA MAKILINGIANA Syd.
On *Psychotria* sp.

MELIOLA MANGIFERAE Earle.
On *Mangifera indica.*

MELIOLA MAPANIAE Yates.
On *Mapania* sp.

MELIOLA MEMECYLI Syd.
On *Memecylon lanceolatum.*

MELIOLA MERREMIAE Rehm.
On *Merremia hastata.*
Merremia hederacea.
Merremia nympheifolia.
Merremia umbellata.
Merremia vitifolia.

MELIOLA MERRILLII Syd.
On *Cissus* sp.
Cissus adnatus.

MELIOLA MICROMERA Syd.
On *Gmelina philippinensis.*

MELIOLA MILLETTIAE Yates.
On *Millettia* sp.

MELIOLA MITRAGYNES Syd.
On *Mitragyna rotundifolia.*

MELIOLA MUSSAENDAE Syd.
On *Mussaenda philippina.*

MELIOLA NIGRORUFESCENS Sacc.
On *Canarium* sp.
Teramnus uncinatus.

MELIOLA OLIGOMERA Syd.
On *Turpinia* sp.

MELIOLA OPACA Syd.
On *Dracontomelum dao.*

MELIOLA PALAWANENSIS Syd.
On *Morinda bartlingii.*

MELIOLA PANICI Earle.
On *Panicum* sp.

MELIOLA PANICICOLA Syd.
On *Panicum palmaefolium.*
Panicum pilipes.

MELIOLA PARENCHYMATICA Gaillard.
On *Desmodium gangeticum.*
Rottboellia exaltata.
Sapindus saponaria.
Sapindus turczaninowii.

MELIOLA PATENS Syd.
On *Lunasia amara.*

MELIOLA PELLICULOSA Syd.
On *Lumnitzeraracemosa.*

MELIOLA PENICILLIFORMIS Gaill.
On *Mallotus philippinensis.*

MELIOLA PEREGRINA Syd.
On *Maesa laxa.*

MELIOLA PERPUSILLA Syd.
On *Tylophora* sp.
Tylophora perrottetii.

MELIOLA PIPERIS Syd.
On *Piper* sp.

MELIOLA POLYTRYCHA Kalch. & Cke.
On *Ardisia* sp.

MELIOLA PULCHERRIMA Syd.
On *Eugenia jambolana.*

MELIOLA QUADRIFURCATA Rehm.
On *Ipomoea* sp.

MELIOLA QUADRISPINA Rac.
On *Hewittia sublobata.*
Merremia umbellata.

MELIOLA RAMOSI Syd.
On *Homonoia riparia.*

MELIOLA RIZALENSIS Syd.
On *Vitex parviflora.*

MELIOLA ROUREAE Yates.
On *Rourea erecta.*

MELIOLA SACCHARI Syd.
On *Imperata cylindrica.*
Saccharum spontaneum.

MELIOLA SAKAWENSIS Henn.
On *Clerodendron intermedium.*

MELIOLA SANDORICI Rehm.
On *Sandoricum koetjape.*

MELIOLA SAUROPICOLA Yates.
On *Sauropus* sp.

MELIOLA SCAEVOLAE Syd.
On *Scaevola frutescens.*

MELIOLA SIDAE Rehm.
On *Sida acuta.*
Sida carpinfolia.
Sida mysorensis.
Sida javensis.

MELIOLA STENOSPORA Wint.
On *Ehretia manesii.*
Piper sp.

MELIOLA SUBAPODA Syd.
On *Mallotus philippinensis.*

MELIOLA SUBSTENOSPORA v. Hoehn.
On *Oplismenus compositus.*

MELIOLA SUBSTENOSPORA v. Hoehn. f. ROTTBOELLIAE Rehm.
On *Rottboellia* sp.
Rottboellia exaltata.
Rottboellia ophiuroides.

MELIOLA TAMARINDI Syd.
On *Tamarindus indica.*

MELIOLA TAYABENSIS Yates.
On *Linociera* sp.

MELIOLA TELOSMAE Rehm.
On *Telosma* sp.
Telosma procumbens.

MELIOLA TERAMNI Syd.
On *Teramnus uncinatus.*

MELIOLA TERAMNIAE Yates.
On *Teramnus labiatus.*

MELIOLA TRACHELOSPERMA Yates.
On *Trachelosperum* sp.

MELIOLA UMIRAYENSIS Yates.
On *Ficus* sp.

MELIOLA UNCARIAE Rehm.
On *Uncaria perrottetii.*

MELIOLA UVARIAE Rehm.
On *Uvaria* sp.

MELIOLA VIBURNI Syd.
On *Viburnum odoratissimum.*

MELIOLA WRIGHTIAE Yates.
On *Wrightia laniti.*

MELIOLINA ARBORESCENS Syd.
On *Eugenia* sp.
Eugenia globosa.

MELIOLINA RADIANS Syd.
On *Eugenia xanthophylla.*

MELIOLINA YATESII Syd.
On *Viburnum* sp.

NEMATOTHECIUM VINOSUM Syd.
On *Eugenia incarnata.*

PARASTERINA PEMPHIDIOIDES Cke.
On *Eugenia* sp.

SETELLA DISSEMINATA Syd.
On *Bambusa* sp.
Schizostachyum longispiculatum.

YATESULA CALAMI Syd.
On *Calamus* sp.

ENGLERULACEAE

THEISSENULA CLAVISPORA Syd.
On *Schizostachyum diffusum.*

THRAUSTA AFFINIS Syd.
On *Pygeum* sp.

THRAUSTA MEDINILLAE (Rac.) Theiss.
On *Medinilla* sp.
Medinilla compressicaulis.
Medinilla myriantha.

CAPNODIACEAE

AITHALODERMA CLAVATISPORUM Syd.
On *Ardisia* sp.
Citrus hystrix.
Ixora sp.
Sandoricum koetjape.
Voacanga globosa.

AITHALODERMA LONGISETUM Syd.
On *Coffea liberica.*
Psidium guajava.

BALLADYNA MEDINILLAE Rac.
On *Medinilla myriantha.*

BALLADYNA MELODORI Syd.
On *Melodorum* sp.

BALLADYNA UNCINATA Syd.
On *Bambusa.*
Schizostachyum sp.

BALLADYNA VELUTINA (B. & C.) v. Hoehn.
On *Gardenia angusta.*
Gardenia glutinosa.
Plectronia didyma.

BALLADYNOPSIS PHILIPPINENSIS (Theiss.) Syd.
On *Morinda* sp.

CAPNODIUM FOOTII Berk. and Desm.
On leaves of *Cocos nucifera.*

HENNINGSOMYCES PHILIPPINENSIS Syd.
On *Morinda* sp.

HENNINGSOMYCES PUSILLUS Syd.
On *Adenia* sp.

LIMACINA INPERSPICUA Sacc.
On *Celtis* sp.

LIMACINULA BISEPTATA Sacc.
On *Macaranga* sp.
Macaranga tanarius.

PHAEOSACCARDINULA FICINA Theiss. & Syd.
On *Ficus ulmifolia.*
Payena leerii.
Uvaria sp.

PHAEOSACCARDINULA MALLOTI (Rehm) Theiss. & Syd.
On *Mallotus philippinensis.*

TRICHOTHYRIACEAE

LORANTHOMYCES SORDIDULUS (Lev.) v. Hoehn.
On *Loranthus* sp.
Loranthus haenkeanus.

TRICHOPELTOPSIS REPTANS (B. & C.) v. Hoehn.
On *Ardisia* sp.

HEMISPHAERIALES

STIGMATEACEAE

AULACOSTROMA PALAWANENSE Syd.
On *Pandanus* sp.
Pandanus gracilis.
Pandanus luzonensis.
Pandanus tectorius.

COLERA CHAETOMIUM (Kunze) Rabh.
On *Rubus pectinellus.*

STIGMATODOTHIS PALAWANENSIS Syd.
On *Dendrobium* sp.

POLYSTOMELLACEAE

ACTINODOTHIS PIPERIS Syd.
On *Piper* sp.
Piper retrofractum.

ARMATELLA LITSEAE (P. Henn.) Theiss. and Syd.
On *Neolitsea* sp.

CHAETASPIS STENOCHLAENAE Syd.
On *Stenochlaena palustris.*

ELLISIODOTHIS MICRODISCA Syd.
On *Freycinetia* sp.

ELLISIODOTHIS PANDANI Syd.
On *Pandanus luzonensis.*

HYSTEROSTOMELLA ALSOPHILAE Rac.
On *Cyathea caudata.*

INOCYCLUS PSYCHOTRIAE Syd.
On *Psychotria luzonensis.*

MARCHALIA CONSTELLATA (B. & Br.) Sacc.
On *Artocarpus* sp.

MENDOGIA BAMBUSINA Syd.
On *Bambusa* sp.

MUNKIELLA MELASTOMATA v. Hoehn.
On *Melastoma fuscum.*

RHIPIDOCARPON JAVANICUM (Pat.) Theiss. and Syd.
On *Nipa fructicans.*

SCHNEEPIA HYMENOLEPIDIS (P. Henn.) Theiss. and Syd.
On *Hymenolepis* sp.

SYMPELTIS LORANTHI Syd.
On *Loranthus pentagonis.*

MICROTHYRIACEAE

ASTERINA ANISOPTERAE Syd.
On *Anisoptera thurifera.*

ASTERINA ASTRONIAE Yates.
On *Astronia* sp.

ASTERINA BAKERI Syd.
On *Calamus* sp.

ASTERINA BREYNIAE Syd.
On *Breynia cernua.*

ASTERINA CAMARINENSIS Syd.
On *Parashorea plicata.*

ASTERINA CANTHII Yates.
On *Canthium* sp.

ASTERINA CAPPARIDIS Syd.
On *Capparis horrida.*

ASTERINA CASSIAE Syd.
On *Glochidion llanosii.*
Phyllanthus reticulatus.

ASTERINA COLLICULOSA Speg.
On *Eugenia cumingii.*

ASTERINA CYLINDROPHORA Syd.
On *Scolopia* sp.

ASTERINA DECIPIENS Syd.
On *Champereia manillana.*

ASTERINA DENSA Syd.
On *Pittosporum pentandrum.*

ASTERINA DERRIDIS Henn.
On *Derris uliginosa.*

ASTERINA DIAPHANA Syd.
On *Solanum manucaling.*

ASTERINA DIAPHORELLA Syd.
On *Sideroxylon ferrugineum.*

ASTERINA DILLENIAE Syd.
On *Dillenia* sp.
Dillenia philippinensis.

ASTERINA DIPTEROCARPI Syd.
On *Dipterocarpus grandiflorus.*

ASTERINA DITISSIMA Syd.
On *Eugenia* sp.

ASTERINA ELAEOCARPI Syd.
On *Elaeocarpus argentea.*
Elaeocarpus pendulus.

ASTERINA ELMERI Syd.
On *Champereia manillana.*

ASTERINA ESCHARIOIDES Syd.
On *Heterostema angustilobum.*
Pittosporum clementis.
Quisqualis indica.

ASTERINA EUGENIAE Yates.
On *Eugenia* sp.

ASTERINA FAGARIAE Yates.
On *Fagara avicennae.*

ASTERINA FALLACIOSA Syd.
On *Canarium* sp.

ASTERINA GMELINAE Sacc.
On *Gmelina* sp.

ASTERINA GRAMMOCARPA Syd.
On *Symplocos* sp.

ASTERINA JASMINICOLA Yates.
On *Jasminum* sp.

ASTERINA LAWSONIAE P. Henn. & Nym.
On *Jasminum* sp.
Lawsonia inermis.

ASTERINA LAXIUSCULA Syd.
On *Sideroxylon angustifolium.*
Sideroxylon apoense.

ASTERINA LITSEAE Yates.
On *Litsea* sp.
Litsea glutinosa.
Litsea perrottetii.

ASTERINA LOBATA Syd.
On *Eugenia* sp.
Picrasma javanica.
Picrasma philippinensis.

ASTERINA LOBULIFERA Syd.
On *Glochidion* sp.

ASTERINA LOPHOPETALI Rehm.
On *Lophopetalum toxicum.*

ASTERINA MELANOMERA Syd.
On *Dasymaschala clusiflora.*

ASTERINA MERRILLII Syd.
On *Cissus* sp.

ASTERINA MOMORDICAE Yates.
On *Momordica charantia.*

ASTERINA NEOLITSEAE Yates.
On *Neolitsea* sp.

ASTERINA NODULIFERA Syd.
On *Anegelsis splendens.*

ASTERINA NYCTOCALIAE Yates.
On *Nycticalus cuspidatum.*

ASTERINA OLIGOCARPA Syd.
On *Olax imbricata.*

ASTERINA OPPOSITA Syd.
On *Heynea sumatrana.*

ASTERINA PEMPHIDIOIDES Cke.
On *Eugenia* sp.

ASTERINA PERPUSILLA Syd.
On *Alangium chinensis.*
Mallotus ricinoides.

ASTERINA PIPERINA Syd.
On *Piper* sp.

ASTERINA PIPTURI Syd.
On *Pipturus arborescens.*

ASTERINA PLATYPODA Syd.
On *Urophyllum banahaense.*

ASTERINA PORRIGINOSA Syd.
On *Ilex cymosa.*

ASTERINA RAMOSII Yates.
On *Dillenia* sp.

ASTERINA SAGINATA Syd.
On *Polyalthia* sp.

ASTERINA SHOREANA Sacc.
On *Parashorea plicata.*

ASTERINA SIMILLIMA Syd.
On *Luffa cylindrica.*

ASTERINA SPHAEROPODA Syd.
On *Ostodes* sp.

ASTERINA SPISSA Syd.
On *Dillenia* sp.

ASTERINA SPONIAE Rac.
On *Trema orientalis*.

ASTERINA TRACHYCARPA Syd.
On *Derris atroviolacea*.

ASTERINA ZIZYPHAIAE Yates.
On *Zizyphus* sp.

ASTERINELLA ANAMIRTAE Syd.
On *Anamirta cocculus*.

ASTERINELLA CALAMI Syd.
On *Calamus* sp.

ASTERINELLA DIPTEROCARPIAE Syd.
On *Dipterocarpus grandiflorus*.

ASTERINELLA DISTINGUENDA Syd.
On *Ixora philippinensis*.

ASTERINELLA GRACILIS Syd.
On *Derris heptaphylla*.

ASTERINELLA HYDNOCARPIAE Yates.
On *Hydnocarpus subfalcatus*.

ASTERINELLA LORANTHI Syd.
On *Loranthus leytensis*.

ASTERINELLA LUGUBRIS Syd.
On *Ixora philippinensis*.

ASTERINELLA LUZONENSIS Syd.
On *Shorea polysperma*.

ASTERINELLA OBESA Syd.
On *Canarium* sp.

ASTERINELLA PALAWANENSIS Syd.
On *Plectronia* sp.

ASTERINELLA RAMULIGERA Syd.
On *Microdesmis casearifolia*.

ASTERINELLA SAGINATA Syd.
On *Pinanga* sp.
Pinanga elmeri.

ASTERINELLA SANTIRICA Syd.
On *Santiria nitida*

CAENOTHYRIUM ALANGALANG Theiss. and Syd.
On *Imperata cylindrica*.

ECHIDNODELLA LINEARIS Theiss. and Syd.
On *Cyperus* sp.

ENGLERULASTER ATRIDES Syd.
On *Adenia coccinea*.

MYIOCOPRELLA BAKERI Sacc.
On *Aspidium* sp.

MYIOCOPRON CONJUNCTUM Syd.
On *Daemonorops* sp.

MORENOELLA ANISOPTERAE Syd.
On *Anisoptera thurifera*.

MORENOELLA BAKERI Syd.
On *Dipterocarpus exima*.
Shorea polysperma.

MORENOELLA BEILSCHMIEDIAE Yates.
On *Beilschmiedia nervosa*.

MORENOELLA FRAGRAEAE Syd.
On *Fragraea racemosa*.

MORENOELLA IRREGULARIS (Syd.) Theiss.
On *Vatica obtusifolia*.

MORENOELLA LAGUNENSIS Syd.
On *Neolitsea* sp.

MORENOELLA LOPHOPETALI (Rehm.) Theiss.
On *Lophopetalum toxicum*.

MORENOELLA MEMECYLI Syd.
On *Memecylon lanceolatum*.
Memecylon subfurfuraceum.

MORENOELLA POTHOIDI (Rehm.) Syd.
On *Pothoidium lobbianum*.

MORENOELLA SAMARENSIS Syd.
On *Stephania* sp.

PARMULARIA HYMENOLEPIDIS Henn.
On *Hymenolepis spicata*.

PELTELLA CONJUNCTA Syd.
On *Calamus* sp.
Calamus mitis.
Daemonorops sp.

PHRAGMOTHYRIELLA BAKERI Rehm.
On *Eugenia* sp.

PYCNODERMA BAMBUSINA Syd.
On *Schizostachyum* sp.

PYCNODERMA CIRCINANS Syd.
On *Bambusa* sp.

PYCNOPELTIS BAKERI Syd.
On *Ardisia* sp.

SCOLECOPELTIS BAKERI Syd.
On *Aglaia harmsiana*.
Celtis philippinensis.
Tetrastigma sepulchrei.

SCOLECOPELTIS CONNARI Syd.
On *Connarus neurocalyx*.

SCOLECOPELTIS GARCINAE Rehm.
On *Garcinia venulosa*.

SEYNESIA ALSTONIAE Koord.
On *Alstonia macrophylla.*

SEYNESIA CLAVISPORA Rehm.
On *Alyxia monilifera.*

SEYNESIA FICINA Syd.
On *Ficus nota.*

SEYNESIA IPOMOEAE Syd.
On *Ipomoea obscura.*

SEYNESIA SCUTELLIUM Syd.
On *Drimys piperata.*

STEPHANOTHECA MICROMERA Syd.
On *Taxotrophis ilicifolia.*

TRICHOPELTACEAE

PYCNOCARPON FIMBRIATUM Syd.
On *Hopea plagata.*

PYCNOCARPON NODULOSUM Syd.
On *Parinarium corymbosum.*

PYCNOCARPON PARASHOREAE Syd.
On *Parashorea plicata.*

HEMISPHAERIACEAE

CHAETOPLACA MEMECYLI Syd.
On *Memecylon* sp.

DICTYOTHYRELLA HETEROSPERMA Syd.
On *Ficus caudatifolia*
Knema heterophylla.
Neotrewia cumingii.
Nephelium mutabile.

DICTYOTHYRELLA MUCOSA Syd.
On *Celtis philippinensis.*
Coffea excelsa.

DICTYOTHYRIUM GIGANTEUM Syd.
On *Memecylon* sp.
Memecylon lanceolatum.

EREMOTHECA PHILIPPINENSIS Syd.
On *Celtis philippinensis.*
Garcinia venulosa.
Strombosia philippinensis.

EREMOTHECELLA CALAMICOLA Syd.
On *Calamus* sp.

MICROPELTELLA AGUSANENSIS Syd.
On *Parkia sherfessei.*

MICROPELTELLA CAMARINENSIS Syd.
On *Lansium dubium.*

MICROPELTELLA CLAVISPORA Syd.
On *Memecylon lanceolatum.*

MICROPELTELLA COERULESCENS Rehm.
On *Hoya luzonensis.*

MICROPELTELLA CONSIMILIS Syd.
On *Canarium luzonicum.*
Derris sp.

MICROPELTELLA MAKILINGIANA Syd.
On *Aglaia diffusa.*

MICROPELTELLA MEGASPERMA Syd.
On *Eugenia* sp.

MICROPELTELLA MEMECYLI Syd.
On *Memecylon lanceolatum.*

MICROPELTELLA MERRILLII Syd.
On *Glycosmis cochinchinensis.*
Celastrus paniculata.

MICROPELTELLA PAETENSIS Syd.
On *Dichapatalum* sp.
Garcinia venulosa.

MICROPELTELLA SCHMIDTIANA (Rost.) Rehm.
On *Lophopetalum toxicum.*
Schizostachyum sp.
Semecarpus cuneiformis.

MICROPELTIS sp.
On *Derris philippinensis.*
Guioa perrottetii.
Homalonema philippinensis.

MICROPELTIS ACALYPHAE Syd.
On *Acalypha stipulacea.*

MICROPELTIS AEQUALIS Syd.
On *Actephila dispersa.*

MICROPELTIS ALBO-MARGINALE Speg.
On *Hoya luzonica.*

MICROPELTIS BAMBUSICOLA Henn.
On *Bambusa* sp.

MICROPELTIS BORNEENSIS Syd.
On *Eugenia* sp.
Ficus caudatifolia.
Goniothalamus elmeri.

MICROPELTIS CORRUSCANS Rehm.
On *Synedrella nodiflora.*

MICROPELTIS EUONYMI Syd.
On *Euonymus javanica.*

MICROPELTIS PHILIPPINENSIS Syd.
On *Derris* sp.

MICROPELTIS POMETIAE Rehm.
On *Pometia pinnata.*

MICROPELTIS RHOPALOIDES Syd.
On *Palaquium* sp.

MICROPELTIS SAMARENSIS Syd.
On *Cyclostemon* sp.

MICROPELTIS SEMECARPI Syd.
On *Semecarpus cuneiformis.*

MICROPELTIS SERIATA Rehm.
On *Symphorema luzonicum.*

MICROPELTIS SIMILIS Syd.
On *Bauhinia cumingiana.*

MICROPELTIS VAGABUNDA Speg.
On *Calamus* sp.

MICROTHYRELLA PHILIPPINENSIS Syd.
On *Bauhinia cumingiana.*
Euonymus javanica.
Lepisanthes schizolepis.

MICROTHYRIUM MISCHOCARPI Syd.
On *Mischocarpus fuscesens.*

MICROTHYRIUM RAMOSII Syd.
On *Aganosma acuminata.*

MYRIANGIALES

MYRIANGIACEAE

ANGATIA EUGENIAE Syd.
On *Eugenia* sp.

MYRIANGIUM DURIEUI Mont. and Berk.
On *Rosa* sp.

SACCARDIACEAE

CALOPEZIZA MIRABILIS Syd.
On *Premna odorata.*

HYPOCREALES

NECTRIACEAE

NECTRIA BAINII Massee v. HYPOLEUCA Sacc.
On young fruits *Theobroma cacao.*

NECTRIELLA PTYCHOSPERMATIS Rehm.
On *Ptychosperma macarthurii.*

PARANECTRIA LUXURIANS Rehm.
On *Meliola* on *Maesa laxa.*
Meliola on *Panicum pilipes.*

HYPOCREACEAE

CALONECTRIA COPELANDII Henn.
On *Orchidaceae.*

GIBBERELLA CREBERRIMA Syd.
On living stem of *Scleria* sp.

GIBBERELLA SAUBINETII (Mont.) Sacc.
On *Imperata* sp.

LAMBRO INSIGNIS Rac.
On *Macaranga* sp.

LISEA SPATHOLOBI Rehm.
On *Spatholobus gyrocarpus.*

OPHIONECTRIA ERINACEA Rehm.
On *Bambusa spinosa.*

SPHAEROSTILBE GRACILIPES Tul.
On *Allophylus dimorphus.*

TRICHONECTRIA BAMBUSICOLA Rehm.
On *Bambusa blumeana.*

CLAVICIPITACEAE

EPICHLOE WARBURGIANA Magnus. var. DONACIS Rehm.
On *Donax cannaeformis.*

HYPOCRELLA sp.
On *Canarium villosum.*

HYPOCRELLA BOTRYOSA Syd.
On *Cyperaceae.*

HYPOCRELLA MELAENA Syd.
On *Dillenia philippinensis.*

HYPOCRELLA PERNETTIAE Pat.
On *Ficus ulmifolia.*

HYPOCRELLA PULVINULUS (B. & Br.) Sacc.
On *Panicum pilipes.*

HYPOCRELLA SALACCENSIS (Rac.) Petch.
On *Premna odorata.*

HYPOCRELLA SCHIZOSTACHYII P. Henn.
On *Schizostachyum* sp.

HYPOCRELLA VILIS Syd.
On *Schizostachyum* sp.

USTILAGINOIDEA OCHRACEA P. Henn.
On *Eriochloa* sp.
Panicum auritum.

USTILAGINOIDEA VIRENS (Cke.) Tak.
On *Oryza sativa.*

DOTHIDIALES

DOTHIDIACEAE

AUERSWALDIA ARENGAE Rac.
On *Caryota* sp.

AUERSWALDIA DERRIDIS Henn.
On *Derris elliptica.*

AUERSWALDIA DECIPIENS Rehm.
On *Arenga mindorensis.*

AUERSWALDIA GIGANTOCHLOAE Rehm.
On *Gigantochloa scribneriana.*

BALANSIA CLAVICEPS Speg.
On *Panicum carinatum.*

BALANSIA THANATOPHORA (Lev.) v. Hoehn.
On *Centotheca latifolia.*
Panicum carinatum.

DOTHIDEA PTEROCARPI Syd.
On *Pterocarpus indicus.*

DOTHIDELLA CANARII Rehm.
On *Canarium villosum.*

DOTHIDELLA DERRIDIS (P. Henn.) Theiss.
On *Derris* sp.

DOTHIDELLA GIGANTOCHLOAE (Rehm.) Theiss. and Syd.
On *Gigantochloa levis.*

ELMEROCOCCUM ORBICULA Syd.
On *Cryptocarya todayensis.*

MONTAGNELLACEAE

CYCLODOTHIS PULCHELLA Syd.
On *Piper corylistachyon.*

PHYLLACHORACEAE

CATACAUMA APOENSE Syd. (PHYLLACHORA APOENSIS Syd.)
On *Ficus apoensis.*

CATACAUMA ASPIDEUM (Berk.) Theiss. and Syd.
On *Ficus minahassae.*
Ficus odorata.

CATACAUMA CIRCINATUM Syd. (PHYLLACHORA CIRCINATA Syd.)
On *Ficus chrysolepis.*

CATACAUMA DALBERGIICOLA (Henn.) Theiss. and Syd.
On *Dalbergia ferruginea.*

CATACAUMA ELMERI Syd. (PHYLLACHORA ELMERI Syd.)
On *Ficus* sp.
Ficus ulmifolia.

CATACAUMA FICI-FULVAE Koord.
On *Ficus heterophylla.*
Ficus odorata.
Ficus sinuosa.
Ficus validicaudata.

CATACAUMA GARCIAE Theiss. and Syd.
On *Ficus garciae.*

CATACAUMA INFECTORIUM (Cke.) Theiss. and Syd.
On *Ficus* sp.

CATACAUMA KERNBACHII (P. Henn.) Theiss. and Syd.
On *Ficus flavo-corticis.*

CATACAUMA LAGUNENSE Syd. (PHYLLACHORA LAGUNENSIS Syd.
On *Ficus hauili.*

CATACAUMA SANGUINEUM Syd. (PHYLLACHORA CIRCINATA Syd. v. SANGUINEA Rehm.)
On *Ficus heterophylla.*
Ficus odorata.

CATACAUMA PHYLLANTHOPHYLLUM (P. Henn.) Theiss. and Syd.
On *Phyllanthus* sp.

CATACAUMA PTEROCARPI Syd. (PHYLLACHORA PTEROCARPI Syd.)
On *Pterocarpus indicus.*

CATACAUMA VALSIFORME (Rehm.) Theiss. and Syd. (PHYLLACHORA VALSIFORMIS Rehm.)
On *Ficus crassitora.*

ENDODOTHELLA ALBIZZIAE Syd. (DOTHIDELLA ALBIZZIAE Syd.)
On *Albizzia marginata.*
Bauhinia binata.

MUNKIODOTHIS MELASTOMATA (v. Hoehn.) Theiss. and Syd.
On *Melastoma fuscum.*
Melastoma polyanthum.

OXYDOTHIS LIVISTONAE Syd.
On *Livistona* sp.

PHRAGMOCARPELLA ICHNANTHI (P. Henn.) Theiss. and Syd. (ROUMEGUERIA ICHNANTHI P. Henn.)
On *Ichnanthus* sp.
Ichnanthus pallens.

PHRAGMOCARPELLA FUSISPORA Syd. (HOMOSTEGIA FUSISPORA Syd.)
On leaves of *Bambusa* sp.

PHRAGMOCAUMA KOLOWRATIAE Syd.
On *Kolowratia elegans.*

PHYLLACHORA AFFINIS Theiss. and Syd. (PHYLLACHORA YAPENSIS (P. Henn.) Syd. var. RHYTISMOIDES Rehm.)
On *Derris philippinensis.*

PHYLLACHORA AFZELIAE Syd.
On *Intsia (Afzelia) bijuga.*

PHYLLACHORA AGLAIAE Rehm.
On *Aglaia harmsiana.*

PHYLLACHORA ANDROPOGONIS Karst. and Hariot.
On *Andropogon candolleana.*

PHYLLACHORA ARDISIAE Henn.
On *Ardisia candolleana.*

PHYLLACHORA BAMBUSAE (Rabh.) Sacc.
On *Bambusa spinosa.*

PHYLLACHORA CATERVARIA (Berk.) Sacc.
On *Canarium luzonicum.*
Canarium todayense.

PHYLLACHORA CANARII Henn.
On *Canarium villosum.*

PHYLLACHORA COICIS P. Henn.
On *Coix lachryma-jobi.*

PHYLLACHORA CONGRUENS Rehm.
On *Panicum carinatum.*

PHYLLACHORA CONNARI Syd.
On *Connarus* sp.

PHYLLACHORA CYNODONTIS (Niessl.) Sacc.
On *Cynodon dactylon.*

PHYLLACHORA DALBERGIAE Niessl.
On *Dalbergia* sp.

PHYLLACHORA DISCHIDIAE Syd.
On *Dischidia rosea.*

PHYLLACHORA DIOSCOREAE Schwein.
On *Dioscorea esculentum.*

PHYLLACHORA DONACINA Rehm.
On *Donax cannaeformis.*

PHYLLACHORA EXIGUA Theiss. and Syd.
On *Isachne beneckei.*

PHYLLACHORA GLOCHIDII Syd.
On *Glochidion mindanaense.*

PHYLLACHORA GRAMINIS (Pers.) Fckl.
On *Andropogon sorghum.*
Digitaria consanguinea.

PHYLLACHORA GRAMINIS (Pers.) Fckl. f. PANICI (Schw.) Shear.
On *Panicum palmaefolium.*
Rottboellia tongling.

PHYLLACHORA IMPERATAE Syd.
On *Imperata cylindrica.*

PHYLLACHORA KAERNBACHII Henn.
On *Ficus heterophylla.*

PHYLLACHORA LEPIDA Syd.
On *Litsea tayabensis.*

PHYLLACHORA LUZONENSIS Henn.
On *Milletia* sp.
Milletia cavitensis.
Milletia merrillii.

PHYLLACHORA MACARANGAE Henn.
On *Macaranga* sp.

PHYLLACHORA MINUTA P. Henn.
On *Hibiscus tiliaceus.*

PHYLLACHORA MINUTISSIMA (Wel. and Curr.) Sm.
On *Oplismenus compositus.*

PHYLLACHORA MISCANTHI Syd.
On *Miscanthus sinensis.*

PHYLLACHORA OBLONGISPORA Syd.
On *Dipterocarpus subalpinus.*

PHYLLACHORA OCHNAE Pat. and Har.
On *Ochna* sp.

PHYLLACHORA OPHIURI Syd.
On *Ophiurus corymbosus.*

PHYLLACHORA ORBICULA Rehm.
On *Bambusa blumeana.*

PHYLLACHORA PAHUDIAE Syd.
On *Pahudia rhomboidea.*

PHYLLACHORA PARKIAE Henn.
On *Parkia roxburgii.*
Parkia timoriana.

PHYLLACHORA PHASEOLINA Syd.
On *Phaseolus calcaratus.*

PHYLLACHORA POGONATHERI Syd.
On *Pogonatherum panicum.*

PHYLLACHORA PONGAMIAE (B. & Br.) Petch.
On *Pongamia mitis.*
Pongamia pinnata.

PHYLLACHORA PSEUDES Rehm.
On *Ficus nota.*

PHYLLACHORA PREMNAE Syd.
On *Premna cumingiana.*

PHYLLACHORA PTEROSPERMI Syd.
On *Pterospermum diversifolium.*

PHYLLACHORA PYCREI Syd.
On *Pycreus polystachyus.*

PHYLLACHORA RAMOSI (P. Henn.) Theiss. and Syd.
On *Derris* sp.

PHYLLACHORA ROTTBOELIAE Syd. & Bult.
On *Rottboellia exaltata.*

PHYLLACHORA ROUREAE Syd.
On *Rourea erecta.*

PHYLLACHORA SACCHARI Henn.
On *Andropogon halepense.*
Saccharum officinarum.

PHYLLACHORA SACCHARI-SPONTANEI Syd.
On *Saccharum spontaneum.*

PHYLLACHORA SCHOENICOLA Syd.
On *Schoenus apogon.*

PHYLLACHORA SERIATA Theiss. and Syd.
On *Panicum palmaefolium.*

PHYLLACHORA SHIRAIANA Syd.
On *Arundinaria* sp.
Schizostachyum diffusum.

PHYLLACHORA SORGHI v. Hoehn.
On *Andropogon halepense.*
Andropogon sorghum.

PHYLLACHORA SPINIFERA (Karst. & Har.) v. Hoehn.
On *Ficus* sp.

PHYLLACHORA SPOROBOLI Pat.
On *Sporobolus* sp.

PHYLLACHORA STENOSPORA (B. & Br.) Sacc.
On *Panicum patens.*

PHYLLACHORA TJANKORREH Rac.
On *Bambusa* sp.
Dinochloa sp.

PHYLLACHORA YAPENSIS (P. Henn.) Syd.
On *Derris* sp.
Derris elliptica.

PLACOSTROMA PTEROCARPI (Mass.) Theiss. and Syd.
On *Pterocarpus indicus.*

RHOPOGRAPHUS BLUMEANUS Rehm.
On *Bambusa blumeana*

SCHIZOCHORA ELMERI Syd.
On *Ficus guyeri.*

SCIRRHIA BAMBUSINA Penz. and Sacc.
On *Schizostachyum acutiflorum.*

SCIRRHIA GIGANTOCHLOAE Rehm.
On *Gigantochloa scribneriana.*

SCIRRHIA LUZONENSIS Henn.
On *Bambusa* sp.
Schizostachyum sp.

SCIRRHODOTHIS SERIATA Syd. & Butl.
On *Gigantochloa levis.*

SPHAERODOTHIS ARENGAE (Rac.) Shear. (AUERSWALDIA ARENGAE Rac.)
On *Caryota cumingii.*

SPHAERODOTHIS MERRILLII (P. Henn.) Theiss. and Syd.
On *Freycinetia* sp.
Freycinetia ensifolia.
Freycinetia williamsii.

TELIMENA BAKERI Syd.
On *Schizostachyum* sp.

TELIMENA GRAMINELLA Syd.
On *Paspalum* sp.

TRABUTIA BENGUETENSIS Yates.
On *Ficus benguetensis.*

TRABUTIA ELMERI Theiss. et. Syd.
On *Ficus banahaensis.*

TRABUTIA VERNICOSA Theiss. et. Syd.
On *Ficus ulmifolia.*

SPHAERIALES

SPHAERIACEAE

ACERBIA DONACINA Rehm.
On *Donax cannaeformis.*

APIOSPORA LUZONENSIS P. Henn.
On *Bambusa.*

DARWINIELLA ORBICULA Syd.
On *Cryptocarya todayensis.*

DIDYMELLA ORCHENDES Rehm.
On *Goniothalamus* sp.

DIDYMELLA PANDANICOLA Syd.
On *Pandanus luzonensis.*

GNOMONIA LITSEAE Syd.
On *Litsea glutinosa.*

LAESTADIA FESTIVA Syd.
On *Sumbaviopsis albicans.*

LINOSPORA PANDANI Syd.
On *Pandanus* sp.
Pandanus sabotan.
Pandanus utilissimus.

NEOPECKIA DIFFUSA (Schw.) Sacc. var. MAGNIFICA Rehm.
On *Pandanus sabotan.*

PERIASTER SPATHOLOBIAE Syd.
On *Spatholobus apoensis.*

PERIASTER STRONGYLODONTIS Theiss. and Syd.
On *Strongylodon* sp.

PSEUDOMELIOLA PLACIDA Syd.
On *Semecarpus cuneiformis.*

ROSELLINA COCOES Henn.
On *Arenga saccharifera.*

ROSELLINA CRUSTACEA Rehm.
On living *Schizostachyum.*

ROSELLINA RACHIDIS Rehm.
On *Schizostachyum* sp.

VENTURA LITSEAE Syd.
On *Litsea glutinosa.*

CORYNELIACEAE

CORYNELIA CLAVATA (Linn.) Sacc.
On *Podocarpus costata.*

MYCOSPHAERELLACEAE

GUIGNARDIA ALBICIANS Rehm.
On *Hoya luzonensis.*

GUIGNARDIA ARENGAE Rehm.
On *Caryota* sp.

GUIGNARDIA CREBERRIMA Syd.
On *Capparis horrida.*

GUIGNARDIA FUSCO-CORIACEAE Rehm.
On *Antidesma bunius.*

GUIGNARDIA HEVEAE Syd.
On *Hevea brasiliensis.*

GUIGNARDIA STERCULIAE Rehm.
On *Sterculia foetida.*

MYCOSPHAERELLA ALOCASIAE Syd.
On *Alocasia macrorrhiza.*
Homalomena sp.

MYCOSPHAERELLA ARISTOLOCHIAE Syd.
On *Aristolochia tagala.*

MYCOSPHAERELLA BONAE-NOCTIS Sacc.
On *Calonyction album.*

MYCOSPHAERELLA BRIDELIAE Syd.
On *Bridelia stipularis.*

MYCOSPHAERELLA CARICAE Syd.
On *Carica papaya.*

MYCOSPHAERELLA CREBERRIMA Penz. & Sacc.
On *Erythropalum scandens.*

MYCOSPHAERELLA COLUMBIAE Syd.
On *Columbia serratifolia.*

MYCOSPHAERELLA DIOSCOREICOLA Syd.
On *Dioscorea esculenta.*

MYCOSPHAERELLA DITISSIMA Syd.
On *Lygodium flexuosum.*

MYCOSPHAERELLA ENDOSPERMI Syd.
On *Endospermum peltatum.*

MYCOSPHAERELLA LAGUNENSIS Syd.
On *Dendrochilum* sp.

MYCOSPHAERELLA MERRILLII Yates.
On *Erythropalum scandens.*

MYCOSPHAERELLA MUSAE Speg.
On *Musa cavendishii.*
Musa sapientum.
Musa textilis.

MYCOSPHAERELLA OCULATA Syd.
On *Premna odorata.*

MYCOSPHAERELLA PERICAMPYLI Syd.
On *Pericampylus* sp.
Pericampylus glaucus.

MYCOSPHAERELLA REYESII Syd.
On *Sapindus saponaria.*

MYCOSPHAERELLA ROUREAE Syd.
On *Rourea erecta.*

SPHAERULINA SMILACINCOLA Rehm.
On *Erythropalum scandens.*

STIGMATEA BULLATA Syd.
On *Schefflera mindanaensis.*

STIGMATEA PHILIPPINENSIS Yates.
On *Homalium* sp.

CLYPEOSPHAERIACEAE

ANTHOSTOMELLA SPHAERELLOIDES Sacc.
On *Uvaria sorsogonensis.*

PLEOSPORACEAE

LEPTOSPHAERIA DRYADEA Sacc.
On *Kigelia pinnata*

METASPHAERIA CORRUSCANS Rehm.
On *Capparis horrida.*

METASPHAERIA INCOMPLETA Rehm.
On *Eugenia* sp.

METASPHAERIA MACULANS Rehm.
On *Arenga saccharifera.*

METASPHAERIA PSEUDOSTROMATICA Rehm.
On one of the *Melastomaceae.*

PHYSALOSPORA AFFINIS Sacc.
On *Theobroma* cacao.

PHYSALOSPORA BARRINGTONIAE Syd.
On *Barringtonia* sp.

PHYSALOSPORA BULLATA Syd.
On *Tetrastigma* sp.

PHYSALOSPORA DINOCHLOAE Rehm.
On *Dinochloa* sp.

PHYSALOSPORA EURYAE (Rac.) v. Hoehn.
On *Eurya acuminata.*

PHYSALOSPORA EMBELIAE Yates.
On *Embelia* sp.

PHYSALOSPORA FICINA Syd.
On *Ficus* sp.

PHYSALOSPORA GUIGNARDIOIDES Sacc.
On *Canavalia gladiata.*

PHYSALOSPORA HOYAE Syd.
On *Hoya* sp.

PHYSALOSPORA NITIDULA Sacc.
On *Cordia myxa.*

PHYSALOSPORA RAMOSII (Henn.) Theiss. and Syd.
On *Derris* sp.

PLEOSPHAERULINA PHASEOLI Syd.
On *Phaseolus* sp.

PLEOSPORA MISCANTHIAE Yates.
On *Miscanthus japonicus.*

DIATRYPACEAE

DIATRYPELLA BARLERIAE Syd.
On *Barleria cristata.*

DIATRYPELLA PSIDII Syd.
On *Psidium guajava.*

HYSTERIALES

HYPODERMATACEAE

LOPHODERMIUM PLANCHONIAE Rehm.
On *Planchonia spectabilis.*

HEMIHYSTERIACEAE

ACROSPERMUM ELMERI Syd.
On *Donax cannaeformis.*

HYSTERIACEAE

ALDONA STELLA-NIGRA Rac.
On *Pterocarpus indicus.*
Tetracera sarmentosa.

HYSTERIUM HOYAE Henn.
On *Hoya* sp.

LEMBOSIA BROMELIACEARUM Rehm.
On *Ananas comosus.*

LEMBOSIA CRUSTACEA (Cke.) Theiss.
On *Rhododendron* sp.
Rhododendron schadenbergii.
Rhododendron vidali.

LEMBOSIA DECOLORANS Syd.
On *Quercus ovalis.*

LEMBOSIA DIPTEROCARPI P. Henn.
On *Dipterocarpus grandiflorus.*

LEMBOSIA EUGENIAE Rehm.
On *Eugenia* sp.

LEMBOSIA INCONSPICUA Syd.
On *Guioa* sp.

LEMBOSIA PANDANICOLA (Rehm.) Yates.
On *Pandanus* sp.

LEMBOSIA PAVETTIAE Theiss.
On *Pavettia* sp.

LEMBOSIA PHILIPPINENSIS Syd.
On *Randia* sp.

LEMBOSIA NERVISEQUIA Syd.
On *Litsea* sp.

SCHIZOTHYRIUM ACERIS (Henn. & Lind.) Rac.
On *Acer philippina.*

DISCALES

BULGARIACEAE

BULGARIASTRUM CAESPITOSUM Syd.
On *Capparis sepiaria.*

MOLLISIACEAE

ERINELLA SETULOSA Sacc.
On *Bambusa blumeana.*

MELITTOSPORIOPSIS GIGANTISPORA (Rehm.) Sacc. and Syd.
On *Rhaphidophora* sp.

MELITTOSPORIOPSIS PACHYCARPA Rehm.
On *Rhaphidophora* sp.

MELITTOSPORIOPSIS PSEUDOPEZIZOIDES Rehm.
On *Olax* sp.
Olax imbricata.

MOLLISIA COPELANDII Rehm.
On *Caryota* sp.

MOLLISIA RAVIDA Syd.
On *Lagerstroemia speciosa.*

PSOROTHECIOPSIS DECIPIENS Rehm. var. BISPORA Rehm.
On *Alstonia scholaris.*

HELOTIACEAE

CORYNE MAKILINGIANA Rehm.
On *Tetrastigma* sp.

PHACIDIACEAE

COCCOMYCES CANARII Rehm.
On *Canarium* sp.

COCCOMYCES DUBIUS Rehm.
On *Ficus minahassae.*

COCCOMYCES MEMECYLII Syd.
On *Memecylon lanceolatum.*

NYMANOMYCES ACERIS-LAURINI Rehm.
On *Acer niveum.*

RHYTISMA LAGERSTROEMIAE Henn.
On *Lagerstroemia speciosa.*

RHYTISMA VIBURNI Henn.
On *Viburnum* sp.
Viburnum luzonicum.

GYMNOASCALES

EXOASCACEAE

ELSINOE CANAVALIAE Rac.
On *Canavalia ensiformis.*

TAPHRINA LINEARIS Syd.
On *Globba marantina.*

TAPHRINA MACULANS Bolt.
On *Zingiber zerumbet.*

LABOULBENIALES

LABOULBENIACEAE

LABOULBENIA NODOSTOMAE Thaxt.
On *Nodostoma* sp.

LABOULBENIA OEDIONYCHI Thaxt.
On *Oedionychus* sp.

LABOULBENIA PHILIPPINA Thaxt.
On *Chrysomelid* near *Rhembastus.*

BASIDIOMYCETES

UREDINALES

PUCCINIACEAE

AECIDIUM ALCHORNEAE Sacc.
On *Alchornea* sp.
Alchornea rugosa.

AECIDIUM BANOSENSE Syd.
On juvenile *Vernonia.*

AECIDIUM BLUMEAE P. Henn.
On *Blumea balsamifera.*
Blumea laciniata.

AECIDIUM CLERODENDRI P. Henn.
On *Clerodendron intermedium.*

AECIDIUM KAERNBACHII P. Henn.
On *Lepistemon flavescens.*
Merremia umbellata.
Merremia vitifolia.

AECIDIUM LAGUNENSE Syd.
On *Telosma* sp.
Telosma procumbens.

AECIDIUM LUZONENSIS P. Henn.
On *Phyllanthus* sp.

AECIDIUM MACHILI P. Henn.
On *Machilis* sp.

AECIDIUM MORI Barcl.
On *Morus alba.*

AECIDIUM NUMMULARE Berk.
On *Ceropegia cumingiana.*

AECIDIUM PAEDERIAE Diet.
On *Paederia tomentosa.*

AECIDIUM PARILE Syd.
On *Goniothalamus elmeri.*

AECIDIUM PHYLLANTHIUM Syd.
On *Phyllanthus reticulatus.*

AECIDIUM PLUCHEAE Henn.
On *Pluchea indica.*

AECIDIUM RHYTISMOIDEUM B. & Br.
On *Diospyros discolor.*

AECIDIUM SAMBUCI Schw.
On *Sambucus javanica.*

AECIDIUM STROBILANTHES Berk.
On *Strobilanthes.*

AECIDIUM TORAE Henn.
On *Cassia tora.*

AECIDIUM UVARIAE P. Henn.
On *Uvaria rufa.*

HAMASPORA ACUTISSIMA Syd.
On *Rubus moluccanus.*
Rubus rolfei.

HEMILEIA CANTHII B. & Br.
On *Plectronia (Canthium) peduncularis.*

HEMILEIA VASTATRIX B. & Br.
On *Coffea arabica* L.

KUEHNEOLA FICI (Cast.) Butl.
On *Ficus minahassae.*
Morus alba.

KUEHNEOLA GARUGAE Syd.
On *Garuga abilo.*

KUEHNEOLA GOSSYPII Arth.
On *Gossypium* sp.

PHRAGMIDIUM DISCIFLORUM (Tode.) James.
On *Rosa* sp.

PUCCINIA sp.
On *Smilax* sp.

PUCCINIA ARGENTATA (Schultz.) Wint.
On *Impatiens* sp.

PUCCINIA BENGUETENSIS Syd.
On *Pollinia* sp.

PUCCINIA CITRATA Syd.
On *Andropogon citratus.*

PUCCINIA CITRANA Syd.
On *Smilax* sp.

PUCCINIA CLAOXYLI Syd.
On *Claoxylon* sp.

PUCCINIA CONGESTA B. & Br.
On *Polygonum chinense.*
Polygonum tomentosum.

PUCCINIA CONVOVULI (Pers.) Cast.
On *Merremia umbellata.*

PUCCINIA CYPERI Arth.
On *Cyperus* sp.

PUCCINIA ENGLERIANA Henn.
On *Tabernaemontana pandacaqui.*

PUCCINIA EREBIA Syd.
On *Clerodendron commersonii.*

PUCCINIA EXHAUSTA Diet.
On *Clematis* sp.

PUCCINIA HETEROSPORA B. & C.
On *Sida javensis.*
Sida mysorensis.
Sida veronicaefolia.

PUCCINIA HYPTIDIS (Curt.) T. & E.
On *Hyptis spicigera.*

PUCCINIA KUEHNII (Krug.) Butler.
On *Saccharum officinarum.*

PUCCINIA LACTUCAE Diet.
On *Lactuca dentata.*

PUCCINIA LEIOCHROMA Syd.
On *Gymnostachyum subcordatum.*

PUCCINIA MELOTHRIICOLA Syd.
On *Melothria mucronata.*

PUCCINIA MERRILLII P. Henn.
On *Smilax bracteata.*
Smilax latifolia.

PUCCINIA MESOMORPHA Syd.
On *Hypoestis* sp.

PUCCINIA MYSORENSIS Syd. & Butl.
On *Kyllingia intermedia.*
Kyllingia monocephala.

PUCCINIA PAULLULA Syd.
On *Amorphophallus campanulatus.*

PUCCINIA PHILIPPINENSIS Syd.
On *Cyperus* sp.
Pycreus nitens.

PUCCINIA PURPUREA Cke.
On *Andropogon halepense.*
Andropogon sorghum.

PUCCINIA ROMAGNOLIANA Maire and Sacc.
On *Cyperus iria.*

PUCCINIA RUFIPES Diet.
On *Imperata cylindrica.*

PUCCINIA SMILACIS-CHINAE P. Henn.
On *Smilax chinense.*

PUCCINIA THWAITESII Berk. and Brm.
On *Justicia gendarussa.*

RAVENALIA BREYNIAE Syd.
On *Breynia rhamnoides.*

RAVENALIA ORNATA Syd.
On *Abrus precatorius.*

SKIERKA CANARII Rac.
On *Canarium villosum.*

SPHAEROPHRAGMIUM LUZONICUM Yates.
On *Albizzia procera.*

TRIPHRAGMIUM THWAITESII B. & Br.
On *Neonauclea (Nauclea) bartlingii.*
Schefflera sp.

UREDO ABRI Henn.
On *Abrus precatorius.*

UREDO ACORI Rac.
On *Acorus* sp.

UREDO ANTIDESMAE Rac.
On *Antidesma ghaesembilla.*

UREDO ARTHRAXONIS-CILIARIS P. Henn.
On *Arthraxon* sp.

UREDO CASTANEAE Henn.
On *Castanea vulgaris.*

UREDO CLAOXYLI Sacc.
On *Claoxylon* sp.

UREDO COSTINA Syd.
On *Costus speciosus.*

UREDO DAVAOENSIS Syd.
On *Cyanotis* sp.

UREDO DESMIUM (B. & Br.) Petch.
On *Gossypium brasiliensis.*

UREDO DIOSCOREAE-ALATAE Rac.
On *Dioscorea alata.*

UREDO ERYTHRINAE Henn.
On *Erythrina indica.*

UREDO FICI Cost.
On *Ficus carica.*

UREDO HYGROPHILAE Syd.
On *Hygrophila salicifolia.*

UREDO MANILENSIS Syd.
On *Tabernaemontana polygamis.*

UREDO NERVISEDA Syd.
On *Wedelia biflora.*

UREDO GAMBOENSIS P. Henn.
On *Albizzia lebbek.*

UREDO OCHRACEA Diet.
On *Commelina benghalensis.*

UREDO OPERCULINAE Syd.
On *Operculina turpethum.*

UREDO PASPALINA Syd.
On *Paspalum scrobiculatum.*

UREDO PHILIPPINENSIS Syd.
On *Cyperus polystachyus.*
Cyperus rotundus.

UREDO PREMNAE Koord.
On *Premna cumingiana.*
Premna vestita.

UREDO RHAPHIDOPHORAE Sacc.
On *Rhaphidophora merrillii.*

UREDO ROSTRUPII Henn.
On *Fuirena glomerata.*

UREDO VIGNAE Bre.
On *Phaseolus* sp.
Vigna sp.

UREDO WEDELIAE-BIFLORAE Syd.
On *Wedelia biflora.*

UROMYCES APPENDICULATUS (Pers.) Lk.
On *Phaseolus mungo.*
Vigna marina.

UROMYCES BIDENTIS Lagh.
On *Bidens pilosa.*

UROMYCES DEERINGIAE Syd.
On *Deeringia* sp.
Deeringia indica.

UROMYCES HEWITTIAE Syd.
On *Hewittia* sp.
Hewittia bicolor.

UROMYCES LINEARIS B. & Br.
On *Panicum repens.*
Panicum flavidum.

UROMYCES MALLOTI P. Henn.
On *Mallotus moluccanus.*

UROMYCES MUCUNAE Rabh.
On *Mucuna lyoni.*

UROMYCES SETARIAE-ITALICAE (Diet.) Yoshino.
On *Setaria italica.*

UROMYCES SOJAE (P. Henn.) Syd.
On *Glycine max (hispida)*

UROMYCES WEDELIAE P. Henn.
On *Wedelia biflora.*

MELAMPSORACEAE

MELAMPSORA CINGENS Syd. (SCHROETERIASTER CINGENS Syd.
On *Bridelia tomentosa.*

PUCCINIASTRUM BOEHMERIAE Syd.
On *Boehmeria* sp.

CRONARTIACEAE

CRONARTIUM ANTIDESMAE-DIOICAE Syd.
On *Antidesma ghesaembilla.*

PHACOSPORA MELIOSMAE Kusano.
On *Meliosma* sp.

PHACOSPORA PACHYRHIZI Syd.
On *Pachyrhizus angulatus.*

PHACOSPORA PHYLLANTHI Diet.
On *Phyllanthus* sp.

PUCCINIOSTELE CLARKIANA (Berk.) Diet.
On *Astilbe philippinensis.*

COLEOSPORIACEAE

COLEOSPORIUM CAMPANULAE (Pers.) Lev.
On *Lobelia nicotianaefolia.*

COLEOSPORIUM EXACI Syd.
On *Exacum chironioides (tetragonum.)*

COLEOSPORIUM KNOXIAE Syd.
On *Knoxia corymbosa.*

COLEOSPORIUM MERRILLII Henn.
On *Orchidaceae.*
Spathoglottis chrysantha.

USTILAGINALES

USTILAGINACEAE

CEREBELLA ANDROPOGONIS Ces.
On *Andropogon micranthus.*

CINTRACTIA AXICOLA (Berk.) Cornu.
On *Fimbristylis diphylla.*

CINTRACTIA CYPERI-POLYSTACHYI P. Henn.
On *Cyperus polystachyus.*

CINTRACTIA LEOCODERMA (Berk.) P. Henn.
On *Rhynchospora corymbosa.*
Rhynchospora glauca.

ENTYLOMA ORYZAE Syd.
On *Oryza sativa.*

FARYSIA MERRILLII (Henn.) Syd.
On *Carex* sp.

GRAPHIOLA ARENGAE Rac.
On *Arenga ambong.*

GRAPHIOLA CYLINDROSPORA Syd.
On *Livistona* sp.

SPHACELOTHECA HYDROPIPERIS (Schum.) De Bary.
On flowers of *Polygonum* sp.

TILLETIA OPACA Syd.
On *Spinifex squarrosus.*

TOLYPOSPORIUM PHILIPPINENSIS Syd.
On *Andropogon contortus.*

USTILAGO ANDROPOGONIS-ACICULATI Petch.
On *Andropogon aciculatus.*

USTILAGO BURSA Berk.
On *Themeda triandra.*

USTILAGO EMODENSIS Berk.
On *Polygonum* sp.

USTILAGO ENDOTRICHA Berk.
On *Carex rafflesiana.*

USTILAGO FLAGELLATA Syd.
On *Rottboellia exaltata.*

USTILAGO ISACHNES Syd.
On *Isachne miliacea.*

USTILAGO ISCHAEMI Fukl.
On *Andropogon halepense.*

USTILAGO KOORDERSIANA Bref.
On *Polygonum barbatum.*

USTILAGO KUSANOI Syd.
On *Miscanthus* sp.

USTILAGO MANILENSIS Syd.
On *Panicum* sp.

USTILAGO PANICI-MILIACEI (Pers.) Wint.
On *Panicum* sp.

USTILAGO REILIANA Kohn.
On *Andropogon* sp.

USTILAGO SACCHARI Rabn.
On *Andropogon sorghum.*
Saccharum officinarum.
Saccharum spontaneum.

USTILAGO SORGHI (Link.) Pass.
On *Andropogon halepense* var. *propinqua.*
Andropogon sorghum.

USTILAGO TONGLINENSIS Tracy and Earle.
On *Ischaemum aristatum.*

USTILAGO ZEAE (Berk.) Ung.
On *Zea mays.*

AGARICALES

THELEPHORACEAE

CORTICUM SALMONICOLOR B. & Br.
On *Anona muricata.*
Artocarpus integra.
Citrus maxima.
Coffea sp.
Gliricidia sepium.
Hevea braziliensis.
Mangifera indica.
Nerium indicum.

SEPTOBASIDIUM MAKILINGIANUM Syd.
On Coccids on *Asteronia* sp.

SEPTOBASIDIUM MICHELIANUM (Cold.) Pat.
On Coccids on *Asteronia* sp.

SEPTOBASIDIUM MOLLIUSCULUM Syd.
On *Litsea caesifolia.*

SEPTOBASIDIUM PHYLLOPHILUM Syd.
On *Dracaena angustifolia.*

PHOMATALES (SPHAEROSIDALES)

PHOMATACEAE (SPHAEROPSIDACEAE)

ASCOCHYTA BANOSENSIS Syd.
On *Codiaeum variegatum.*

BOTRYODIPLODIA CALAMINA Sacc.
On *Calamus* sp.

BOTRYODIPLODIA FILIGERA Sacc.
On *Antidesma* sp.

BOTRYODIPLODIA TANARIA Sacc.
On *Macaranga tanarius.*

CEUTHOSPORA GARCINIAE Syd.
On *Garcinia* sp.

CEUTHOCARPON DEPOKENSE Penz. & Sacc.
On *Dracontomelum edule.*

CEUTHOCARPON PUNCTIFORME Sacc.
On *Sterculia* sp.

DIPLODIA ANTHOPHILA Sacc.
On flowers of *Caryota cumingii.*

DIPLODIA ANANASSAE Sacc.
On *Ananas sativus.*

DIPLODIA ARENGOCARPA Sacc.
On *Arenga pinnata (sacchari-fera.)*

DIPLODIA CARICAE Sacc.
On *Carica papaya.*

DIPLODIA FRUCTUS-PANDANI Henn. f. FOLIORUM Sacc.
On *Pandanus sabotan.*

DIPLODIA PHASEOLINA Sacc.
On pods *Phaseolus lunatus.*

DOTHIOPSIS PHILIPPINENSIS Yates.
On *Mastixia philippinensis.*

HENDERSONIA CELASTRI Yates.
On *Celastrus paniculata.*

HENDERSONIA COICIS Sacc.
On *Coix lacryma-jobi.*

LASIODIPLODIA THEOBBROMAE (Pat.) Griff. and Maubl.
On roots of *Ipomoea batatas.*
Citrus maxima.

MACRODIPLODIA PANDANI Died.
On *Pandanus luzonensis.*

MACROPHOMA CYANOPSIDIS Syd.
On *Cyanopsis psoraleoides.*

MACROPHOMA EUPHORBIAE Syd.
On *Euphorbia heterophylla.*

MACROPHOMA OBSOLETA Sacc.
On *Capparis horrida.*

MACROPHOMA MUSAE (Cke.) Berl. & Vlg.
On *Musa sapientum.*

MICRODIPLODIA PASSERINIANA (Thum.) Allesch.
On *Arenga pinnata (sacchari-fera.)*

PAZSCHKEELEA PHILIPPINENSIS Yates.
On *Dunbaria* sp.

PHOMA BAKERIANA Sacc.
On *Vigna unguiculata.*

PHOMA HERBARUM West. var. DYSOXYLI Sacc.
On *Dysoxylon decandrum.*

PHOMOPSIS CESTRI Syd.
On *Cestrum nocturum.*

PHYLLOSTICTA ACORIDII Henn.
On *Dendrochilum* sp.

PHYLLOSTICTA ALLOPHYLAE Syd.
On *Allophylus timorensis.*

PHYLLOSTICTA AMBROSIOIDES Thuem.
On *Chenopodium ambrosioides.*

PHYLLOSTICTA BAKERI Syd
On *Bauhinia malabarica.*

PHYLLOSTICTA BRIDELIAE Graff.
On *Bridelia* sp.

PHYLLOSTICTA COCOPHYLLA Pass.
On seedling *Cocos nucifera.*

PHYLLOSTICTA CODIAE Died.
On *Codiaeum variegatum.*

PHYLLOSTICTA DENSISSIMA Sacc.
On *Capparis horrida.*

PHYLLOSTICTA DYSOXYLI Sacc.
On *Dysoxylum* sp.

PHYLLOSTICTA EUCHLAENAE Sacc.
On *Euchlaena luxurians.*

PHYLLOSTICTA GELONIAE Yates.
On *Gelonium* sp.

PHYLLOSTICTA GLUMARUM (Ell. and Tr.) Miyake.
On *Oryza sativa.*

PHYLLOSTICTA GRAFFIANA Sacc.
On *Dioscorea pentaphylla.*
Dioscorea esculenta.

PHYLLOSTICTA HORTORUM Speg.
On *Solanum melongena.*

PHYLLOSTICTA INSULARUM Sacc.
On *Anona muricata.*

PHYLLOSTICTA KIGELIAE Died.
On *Kigelia pinnata.*

PHYLLOSTICTA MANIHOTICOLA Syd.
On *Manihot dichotoma.*
Manihot glaziovii.
Manihot heptaphylla.

PHYLLOSTICTA MARMORATA Cooke.
On *Mallotus philippinensis.*

PHYLLOSTICTA MICROSTEGIA Syd.
On *Barringtonia racemosa.*

PHYLLOSTICTA MIURAE Miy.
On *Oryza sativa.*

PHYLLOSTICTA PORTIANA Sacc.
On *Alocasia portei.*

PHYLLOSTICTA RAIMUNDOI Sacc.
On *Sapindus* sp.

PHYLLOSTICTA REYESII (Sacc.) Yates.
On *Codiaeum variegatum.*

PHYLLOSTICTA SIPHONODONTIS Sacc.
On *Siphonodon celastrineus.*

PHYLLOSTICTA SUMBAVIAE (?) Syd.
On *Sumbavia rottleroides.*

PLACOSPHAERIA DURIONIS Syd.
On *Durio zibethinus.*

PLACOSPHAERIA TIGLII Henn.
On *Croton tiglium.*

SEPTORIA BAKERI Syd.
On *Leucas lavandulifolia.*
Leucas linifolia.

SEPTORIA LABLABINA Sacc.
On *Dolichos lablab.*

SEPTORIA LABLABIS P. Henn.
On *Dolichos lablab.*

SEPTORIA SONCHIFOLIA Cke.
On *Sonchus oleraceus.*

SEPTORIA MERRILLII Syd.
On *Buddleia asiatica.*

SEPTORIA MOLLERIANA Bres.
On *Canavalia lineata.*

VERMICULARIA CAPSICI Syd.
On *Capsicum annuum.*

VERMICULARIA CONFERTA Sacc.
On *Codiaeum variegatum.*

VERMICULARIA LAGUNENSIS Syd.
On *Phytolacca dioica.*

VERMICULARIA PANDANI Syd.
On *Pandanus reclinatus.*

VERMICULARIA XANTHOSOMATIS Sacc.
On *Xanthosoma sagittifolium.*

YPSILONIA CUSPIDATA Lev.
On *Cyclostemon* sp.
Phaeanthus ebracteatus.

ZYTHIACEAE

(NECTRIOIDIACEAE)

ASCHERSONIA sp.
On Coccids on *Tetrastigma* sp.
Aleyrodids on *Memecylon* sp.
Coccids on a fern.

ASCHERSONIA BADIA Pat.
On *Schizostachyum* sp.

ASCHERSONIA CONFLUENS P. Henn.
On coccids on *Leucosyke* sp.

ASCHERSONIA CINNABARINA Henn.
On *Astronia cumingii.*

ASCHERSONIA CONFLUENS P. Henn.
On *Schizostachyum* sp.

ASCHERSONIA EUGENIAE Koord.
On coccids on *Polypodium myriocarpum.*

ASCHERSONIA LECANOIDES Henn.
On coccids on *Astronia* sp.

ASCHERSONIA MACULARIS Syd.
On coccids on *Mischocarpus* sp.

ASCHERSONIA MICROSPORA (?)
On *Schizostachyum* sp.

ASCHERSONIA NOVO-GUINEENSIS Henn.
On coccids on *Ficus ulmifolia*.

ASCHERSONIA PARAENSIS Henn.
On coccids on *Psidium guajava*.

ASCHERSONIA SCLEROTIOIDEA Henn.
On coccids on *Citrus maxima*.

LEPTOSTROMATACEAE

(PYCNOTHYRIACEAE)

ACTINOTHYRIUM HOPEAE Graff.
On *Hopea pierrei*.

ACTINOTHYRIUM MACULOSUM Sacc.
On *Calamus* sp.

DIEDECKEA SINGULARIS Syd.
On *Polyosma philippinensis*.

DISCOSIELLA CYLINDROSPORA Syd.
On *Gelenium subglomeratum*.

ISCHNOSTROMA MICROMERA Syd.
On *Taxotrophis ilicifolia*.

LASIOTHYRIUM CYCLOSCHIZON Syd.
On *Aegiceras corniculatum*.

LASMENIA FICINA Syd.
On *Ficus disticha*.

LEPTOTHYRIUM CIRCUMSCISSUM Syd.
On *Mangifera indica*.

LEPTOTHYRIUM EROSUM Sacc.
On *Bauhinia monandra*.

MELASMIA CUDRANIAE (Mass.) v. Hoehn.
On *Cudrania javanica*.

MELASMIA EXIGUA Syd.
On *Loranthus* sp.

PYCNOTHYRIUM LOBATUM Syd.
On *Dysoxylon* sp.

EXCIPULACEAE

EPHELIS CARICINA Syd.
On *Carex* sp.

MELANCONIALES

MELANCONIACEAE

COLLETOTRICHUM EUCHROUM Syd.
On *Euphorbia neriifolia*.

COLLETOTRICHUM GLOEOSPORIOIDES Penz.
On *Citrus* sp.

COLLETOTRICHUM ORCHIDEARUM Allesch.
On *Eria ornata*.
Cymbidium sp.
Déndrochilum sp.
Pholidota imbricata.
Rhynchostylus sp.

COLLETOTRICHUM SUMBAVIAE Syd.
On *Sumbavia rottleroides*.

COLLETOTRICHUM PANDANI Syd.
On *Pandanus veitchii*.

CYLINDROSPORIUM BAKERI Syd.
On *Ipomoea* sp.

GLOEOSPORIUM ALCHORNEAE Syd.
On *Alchornea rugosa*.

GLOEOSPORIUM ALSTONIAE Syd.
On *Alstonia scholaris*.

GLOEOSPORIUM CANAVALIAE Rac.
On *Canavalia gladiata*.

GLOEOSPORIUM GRAFFII Engl.
On *Aglaonema densinervium*.

GLOEOSPORIUM HOYAE Syd.
On *Hoya* sp.

GLOEOSPORIUM MELONGENAE Sacc.
On *Solanum melongena*.

GLOEOSPORIUM MERRILLII Syd.
On *Ricinus communis*.

GLOEOSPORIUM MUSARUM C. & M.
On *Musa sapientum*.

GLOEOSPORIUM LEBBEK Syd.
On *Albizzia lebbek*.

GLOEOSPORIUM PALMARUM Oudem.
On leaf sheaths of *Areca catechu*.

GLOEOSPORIUM PERPUSILLUM Sacc.
On *Kleinhofia hospita*.

GLOEOSPORIUM VANILLAE Cke.
On *Vanilla* sp.

MARSONIA PAVONIA Syd.
On *Macaranga* sp.
Macaranga bicolor.

MELANCONIUM PARKIAE Syd.
On *Parkia timoriana.*

MELANCONIUM SACCHARI Mass.
On *Saccharum officinarum.*

PESTALOZZIA sp.
On *Bauhinia* sp.

PESTALOZZIA PAUCISETA Sacc.
On *Litsea glutinosa.*
Mangifera indica.
Nauclea reticulata.
Ptychosperma macarthurii.

PESTALOZZIA FUNEREA Desm.
On *Carissa arduina.*

PESTALOZZIA GIBBERA Sacc.
On *Litsea glutinosa.*

PESTALOZZIA PALMARUM Cke.
On *Areca catechu.*
Arenga mindorensis.
Caryota sp.
Cocos nucifera.
Pandanus luzonensis.
Pinanga sp.

PESTALOZZIA PAUCISETA Sacc.
On *Guioa* sp.
Mangifera indica.
Randia reticulata.

SEPTOGLOEUM ARACHIDIS Rac.
On *Arachis hypogea.*

STEIROCHAETA ANANASSAE Sacc.
On *Ananas sativa.*

MONILIALES

MONILIACEAE

(MUCEDINEAE)

ASPERGILLUS DELACROIXII Sacc. and Syd.
On fruits of *Theobroma cacao.*

ASPERGILLUS FLAVUS (de Bary) Bref.
On *Morinda bracteata.*

ASPERGILLUS PERICONIOIDES Sacc.
On *Carica papaya.*

CERCOSPORELLA UREDINOPHILA Sacc.
On one of Uredinaceae on *Scirpus grossus.*

MYCOGONE CERVINA Ditm. var. THEOBROMAE Sacc.
On young fruits *Theobroma cacao.*

OIDIUM ERYSIPHOIDES Fr.
On *Desmodium procumbens.*
Heliotropium indicum.

OIDIUM OXALIDIS McAlp.
On *Oxalis repens.*

OOSPORA OBDUCENS Syd.
On living *Cicadas.*

OOSPORA HYALINULA Sacc.
On *Citrus* sp.
Puccinia heterospora.
Sida javensis.

OOSPORA PERPUSILLA Sacc.
On *Piper betle.*

DEMATIACEAE

ALTERNARIA BRASSICAE (Berk.) Sacc.
On *Brassica oleracea.*

ALTERNARIA SOLANI (E. & M.) Sor.
On *Solanum tuberosum.*

BRACHYSPORIUM BAKERI Syd.
On *Macaranga* sp.

BRACHYSPORIUM PINI-INSULARIS P. Henn.
On *Pinus insularis.*

CERCOSPORA ACEROSUM Dick. and Henn.
On *Saccharum officinarum.*

CERCOSPORA ALPINIAE Syd.
On *Alpinia* sp.

CERCOSPORA AMORPHOPHALLI P. Henn.
On *Amorphophallus campanulatus.*

CERCOSPORA APII Fries.
On *Apium graveolens.*

CERCOSPORA ARMORACIAE Sacc.
On *Brassica pekinensis.*

CERCOSPORA ARTOCARPI Syd.
On *Artocarpus communis.*

CERCOSPORA AVERRHOI Welles.
On *Averrhoa carambola.*

CERCOSPORA BAKERI Syd.
On *Clerodendron intermedium.*

CERCOSPORA BAUHINIAE Syd.
On *Bauhinia malabarica.*

CERCOSPORA BETICOLA Sacc.
On *Beta vulgaris.*

CERCOSPORA BIOPHYTI Syd.
On *Biophytum sensitivum.*

CERCOSPORA BRASSICICOLA Henn.
On *Brassica pekinensis.*

CERCOSPORA CANAVALIAE Syd.
On *Canavalia gladiata.*

CERCOSPORA COFFEICOLA B. & Cke.
On *Coffea bukobensis.*

CERCOSPORA COSTINA Syd.
On *Costus speciosus.*

CERCOSPORA CRUENTA Sacc.
On *Phaseolus radiatus.*

CERCOSPORA EXTREMORUM Syd.
On *Homalonema philippinensis.*

CERCOSPORA GLIRICIDIAE Syd.
On *Gliricidia sepium.*

CERCOSPORA HELMINTHOSTACHYS P. Henn.
On *Helminthostachyum zeylanicum.*

CERCOSPORA HENNINGSII Allesch.
On *Manihot utilissima.*

CERCOSPORA HIBISCI T. & E.
On *Abelmoschus esculentus.*

CERCOSPORA KLEINHOFIAE v. Hoehn.
On *Kleinhovia hospita.*

CERCOSPORA IMPERATAE Syd.
On *Imperata* sp.

CERCOSPORA KOPKEI K.
On *Saccharum officinarum.*

CERCOSPORA LAGERSTROEMIAE Syd.
On *Lagerstroemia speciosa.*

CERCOSPORA LAGUNENSIS (Sacc.) Yates.
On *Mallotus moluccanus.*

CERCOSPORA LICUALAE Syd.
On *Licuala spinosa.*

CERCOSPORA LITSEA-GLUTINOSAE Syd.
On *Litsea glutinosa.*

CERCOSPORA LUSSONIENSIS Sacc.
On *Phaseolus lunatus.*

CERCOSPORA MACARANGAE Syd.
On *Macaranga tanarius.*

CERCOSPORA MANGIFERAE Koord.
On *Mangifera indica.*

CERCOSPORA MANIHOTIS Henn.
On *Manihot utilissima.*

CERCOSPORA MEDICAGINIS E. & E.
On *Medicago sativa.*

CERCOSPORA MELONGENAE Welles.
On *Solanum melongena.*

CERCOSPORA NICOTIANAE Ell. and Ev.
On *Nicotiana tabacum.*

CERCOSPORA OCCIDENTALIS Cke. var. CASSIA-CARPA Sacc.
On *Cassia occidentalis* L.

CERCOSPORA PACHYDERMA Syd.
On *Dioscorea alata.*
Dioscorea esculenta.

CERCOSPORA PAHUDIAE Syd.
On *Pahudia rhomboidea.*

CERCOSPORA PANTOLEUCA Syd.
On *Clitorea ternatea.*

CERCOSPORA PERSONATA (B. & C.) Ell.
On *Arachis hypogaea.*

CERCOSPORA PUERARIAE Syd.
On *Pueraria phaseoloides.*

CERCOSPORA PUMILA Syd.
On *Derris* sp.

CERCOSPORA RHINACANTHI v. Hoehn.
On *Rhinacanthus nasuta.*

CERCOSPORA SESAMI A. Zim.
On *Sesamum orientale.*

CERCOSPORA STIZOLOBII Syd.
On *Stizolobium* sp.

CERCOSPORA SUBSESSILIS Syd.
On *Melia azedarach.*

CERCOSPORA SUBTORULOSA Syd.
On *Melicopa triphylla.*

CERCOSPORA TABERNAEMONTANAE Syd.
On *Tabernaemontana pandacaqui.*

CERCOSPORA TACCAE Syd.
On *Tacca palmata.*

CERCOSPORA TIGLII Henn.
On *Croton tiglium.*

CERCOSPORA TINOSPORAE Syd.
On *Tinospora reticulata.*

CERCOSPORA TOSENSIS P. Henn.
On *Solanum* sp. (Wild)

CERCOSPORA UBI Rac.
On *Dioscorea esculenta.*

CERCOSPORINA CARTHAMI Syd.
On *Carthamus tinctorius.*

CERCOSPORINA HELICTERIS Syd.
On *Helicteres hirsuta.*

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CERCOSPORIDIUM HELLERI Earle.
On *Sphenoclea zeylanica.*

CLADOSPORIUM HERBARUM (Pers.) Link.
On pods *Phaseolus lunatus.*

CLADOSPORIUM OPLISMENI Syd.
On *Oplismenus undulatifolius*

CLADOSPORIUM SUBFUSOIDEUM McAlp.
On *Citrus* sp.

CONIOSPORIUM PUNCTIFORME Sacc.
On *Dinochloa scandens.*

FUMAGO VAGANS Pers.
On *Andropogon sorghum.*

FUSICLADIUM PONGAMIAE Syd.
On *Pongamia pinnata.*

HADRONEMA ORBICULARIS Syd.
On *Quercus* sp.

HELMINTHOSPORIUM sp.
On *Ficus ulmifolia.*

HELMINTHOSPORIUM BLUMEANUM Sacc.
On *Bambusa blumeana.*

HELMINTHOSPORIUM CORYPHAE Syd.
On *Corypha elata.*

HELMINTHOSPORIUM FICINUM Sacc.
On *Ficus ulmifolia.*
Ficus caudatifolia.

HELMINTHOSPORIUM FLAGELLATUM Yates.
On *Meliola* on *Ardisia disticha.*

HELMINTHOSPORIUM FUMAGINEUM Sacc.
On *Ficus ulmifolia.*

HELMINTHOSPORIUM HEVEAE Petch.
On *Hevea braziliensis.*

HELMINTHOSPORIUM INCONSPICUUM Cke. and Ell.
On *Zea mays.*

HELMINTHOSPORIUM INSIGNE Sacc.
On *Mallotus philippinensis.*

HELMINTHOSPORIUM LEUCOSYKEAE Yates.
On *Meliola* on *Leucosyke capitallata.*

HELMINTHOSPORIUM NODULOSUM B. & C.
On *Eleusine indica.*

HELMINTHOSPORIUM MACULOSUM Sacc.
On *Litsea perrottetii.*

HELMINTHOSPORIUM MELIOLOIDES Sacc.
On *Uvaria* sp.

HELMINTHOSPORIUM PHILIPPINUM Sacc.
On *Arenga tremula.*

HELMINTHOSPORIUM RAVENELII Curt.
On *Sporobolus elongatus.*

HELMINTHOSPORIUM REYESII Died.
On *Guioa perrottetii.*

HELMINTHOSPORIUM CORYPHAE Syd.
On *Corypha elata.*

MONOTOSPORA PARASTICA Syd.
On *Ficus nota.*

RAMULARIA MALLOTI Sacc.
On *Mallotus molluccanus.*

RAMULARIA CATAPPAE Rac.
On *Terminalia catappa.*

STIGMELLA MANILENSIS Sacc.
On *Allophylus dimorphus.*

STIGMELLA PALAWANENSIS Syd.
On *Celastrus paniculata.*

SPIRALOTRICHUM PIPERIS Yates.
On *Piper* sp.

TORULA HERBARUM LK. fo. QUATERNELLA Sacc.
On *Thunbergia grandiflora.*

STILBACEAE

STILBELLA PALAWANENSIS Syd.
On *Celastrus paniculata.*

TUBERCULARIACEAE

CHAETOSTROMA CLADOSPORIOIDES Sacc.
On *Paspalum* sp.

EXOSPORIUM DURUM Sacc.
On *Cocos nucifera.*

EXOSPORIUM HYPOXYLOIDEA Syd.
On *Areca catechu.*

EXOSPORIUM PULCHELLUM Sacc.
On *Orania palindan.*
Ptychosperma macarthurii.

FUSARIUM THEOBROMAE App. and Strunk.
On young fruits *Theobroma cacao.*

HIMANTIA sp.
On *Alstonia scholaris.*

HYMENOPSIS CUDRANIAE Mass.
On *Cudrania javanica.*

ILLOSPORIUM PERMINUTUM Sacc.
On *Macaranga grandifolia.*

ILLOSPORIUM TABACINUM Sacc.
On *Macaranga tanarius.*

PIONNOTES CAPILLACEA Sacc.
On *Persea gratissima.*

OŻONIUM (mycelium sterile)
On *Pterospermum obliquum.*

OZONIUM GLUMICOLA Sacc.
On *Schizostachyum acutiflorum.*

OZONIUM ACUTICORNUM Pers.
On *Eugenia calubcob.*
Litsea glutinosa.
Pterocarpus indicus.
Tectona grandis.

SPEGAZZIANA MELIOLAE A. Zimm.
On *Callicarpa cana.*
Meliola bakeri on *Tetrastigma.*
Meliola vilis on *Callicarpa blancoi.*
Meliola on *Sarauia panduriformis.*
Meliola on *Mussaenda philippica.*
Panicum sp.
Saccharum arundinaceum.

HOST INDEX

ARISTOLOCHIA TAGALA
Mycosphaerella aristolochiae Syd.

ARTHRAXON sp.
Uredo arthraxonis-ciliaris P. Henn.

ARTOCARPUS sp.
Marchalia constellata (B. & Br.) Sacc.
Meliola artocarpiae Yates.

ARTOCARPUS COMMUNIS
Cercospora artocarpi Syd.

ARTOCARPUS INTEGRIFOLIA
Corticum salmonicolor B. & Br.
Rhizopus artocarpi Rac.

ARUNDINARIA sp.
Phyllachora shiriana Syd.

ASPIDIUM sp.
Myiocoprella bakeri Sacc.

ASTERINA PUSILLA
Dimerium rizalense Syd.

ASTILBE PHILIPPINENSIS
Pucciniostele clarkiana (Borch.) Diet.

ASTRONIA CUMINGII
Aschersonia cinnabarina Henn.

ASTRONIA sp.
Aschersonia lecanioides Henn.
Asterina astroniae Yates.
Septobasidium makilingianum Syd.
Septobasidium michelianum Syd. (Cold.) Pat.

AVERRHOA CARAMBOLA
Cercospora averrhoi Welles.

B

BAMBUSA sp.
Apiospora luzonensis P. Henn.
Balladyna uncinata Syd.
Mendogia bambusina Syd.
Micropeltis bambusicola Henn.
Phragmocarpella fusispora Syd.
(*Homostegia fusispora* Syd.)
Phyllachora tjankorreh Rac.
Scirrhia luzonensis Henn.
Setella disseminata Syd.

BAMBUSA SPINOSA
Erinella setulosa Sacc.
Helminthosporium blumeanum Sacc.
Phyllachora orbicula Rehm.
Rhopographus blumeanus Rehm.
Trichonectria bambusicola Rehm.
Ophionectria erinacea Rehm.
Phyllachora bambusae (Rabh.) Sacc.

BARLERIA CRISTATA
Diatrypella barleriae Syd.

BARRINGTONIA sp.
Physalospora barringtoniae Syd.

BARRINGTONIA LUZONIENSIS
Meliola barringtoniae Yates.

BARRINGTONIA RACEMOSA
Phyllosticta microstegia Syd.

BAUHINIA sp.
Meliola bauhiniae Yates.
Pestalozzia sp.

BAUHINIA BINATA
Endodothella albizziae Syd.
(*Dothidella albizziae* Syd.)

BAUHINIA CUMINGIANA
Micropeltis similis Syd.
Microthyrella philippinensis Syd.

BAUHINIA MALABARICA
Cercospora bauhiniae Syd.
Phyllosticta bakeri Syd.

BAUHINIA MONANDEA
Leptothyrium erosum Sacc.

BEILSCHMIEDIA NERVOSA
Morenoella beilschmiediae Yates.

BETA VULGARIS
Cercospora beticola Sacc.

BIDENS PILOSA
Uromyces bidentis Lagh.

BIOPHYTUM SENSITIVUM
Cercospora biophyti Syd.

BLUMEA BALSAMIFERA
Aecidium blumeae P. Henn.

BLUMEA LACINIATA
Aecidium blumeae P. Henn.

BOEHMERIA sp.
Pucciniastrum boehmeriae Syd.

CARICA PAPAYA
Aspergillus periconioides Sacc.
Diplodia caricae Sacc.
Mycosphaerella caricae Syd.
Phytophthora faberi Maubl.

CARISSA ARDUINA
Pestalozzia funerea Desm.

CARTHAMUS TINCTORIUS
Cercosporina carthami Syd.

CARYOTA sp.
Sphaerodothis arengae (Rac.) Shear.
Guignardia arengae Rehm.
Meliola copelandi Rehm.
Pestalozzia palmarum Cke.

CARYOTA CUMINGII
Diplodia anthophila Sacc.
Sphaerodothis arengae (Rac.) Shear.

CASSIA OCCIDENTALIS
Cercospora occidentalis Cke. var. *cassiaecarpa* Sacc.

CASSIA TORA
Aecidium torae Henn.

CASTANEA VULGARIS
Uredo castaneae Henn.

CELASTRUS PANICULATA
Hendersonia celastri Yates.
Micropeltella merrillii Syd.
Stigmella palawanensis Syd.
Stilbella palawanensis Syd.

CELTIS sp.
Limacina imperspicua Sacc.
Meliola celtidiae Yates.

CELTIS PHILIPPINENSIS
Dictyothyriella mucosa Syd.
Eremotheca philippinensis Syd.
Meliola celticola Yates.

CENTOTHECA LATIFOLIA
Balansia thanatophora (Lev.) v. Hoehn.
Ophiodothis thanatophora (Lev.) Rac.

CEROPEGIA CUMINGIANA
Aecidium nummulare Berk.

CESTRUM NOCTURNUM
Phomopsis cestri Syd.

CHAMPEREIA sp.
Meliola champereiae Syd.

CHAMPEREIA MANILLANA
Asterina decipiens Syd.
Asterina elmeri Syd.
Meliola champereiae Syd.

CHENOPODIUM AMBROSIOIDES
Phyllosticta ambrosioides Thuem.

CHRYSOMELID
Laboulbenia philippina Thaxt.

CICADA
Oospora obducens Syd.

CISSUS sp.
Asterina merrillii Syd.
Meliola merrillii Syd.

CISSUS ADNATUS
Meliola merrillii Syd.

CITRUS sp.
Cladosporium subfusoideum Mc-Alp.
Colletotrichum gloeosporioides Pen.
Oospora hyalinula Sacc.

CITRUS HYSTRIX
Aithaloderma clavatisporum Syd.

CITRUS MAXIMA
Aschersonia sclerotioides Henn.
Corticium salmonicolor B. & Br.
Lasiodiplodia theobromae (Pat.) Griff. and Maubl.
Meliola citricola Syd.

CLAOXYLON sp.
Puccinia claoxyli Syd.
Uredo claoxyli Sacc.

CLERODENDRON sp.
Meliola clerodendricola P. Henn.

CLERODENDRON COMMERSONII
Puccinia erebia Syd.

CLERODENDRON INTERMEDIUM Cham.
Aecidium clerodendri P. Henn.
Cercospora bakeri Syd.
Meliola sakawensis Henn.

CLERODENDRON MINAHASSAE
Meliola clerodendricola P. Henn.

CLEMATIS sp.
Puccinia exhausta Diet.

CLITORIA TERNATEA
Cercospora pantoleuca Syd.

CYPERUS sp.
Echidnodella linearis Theiss. and Syd.
Puccinia cyperi Arth.
Puccinia philippinensis Syd.

CYPERUS IRIA
Puccinia romagnoliana Maire & Sacc.

CYPERUS POLYSTACHYUS
Cintractia cyperi-polystachyi Henn.
Uredo philippinensis Syd.

CYPERUS ROTUNDUS
Uredo philippinensis Syd.

CYRTANDRA sp.
Aecidium sp.

D

DAEMONOROPS sp.
Myiocopron conjunctum Syd.
Peltella conjuncta Syd.

DALBERGIA sp.
Phyllachora dalbergiae Niessl.

DALBERGIA FERRUGINEA
Catacauma dalbergiicola (Henn.) Theiss. and Syd.

DASYMASCHALA CLUSIFLORA
Asterina melanomera Syd.

DEERINGIA sp.
Uromyces deeringiae Syd.

DEERINGIA INDICA
Uromyces deeringiae Syd.

DENDROBIUM sp.
Stigmatidothis palawanensis Syd.

DENDROCHILUM sp.
Colletotrichum orchidearum Allesch.
Mycosphaerella lagunensis Syd.
Phyllosticta acoridii Henn.

DERRIS sp.
Cercospora pumila Syd.
Dothidella derridis (P. Henn.) Theiss.
Meliola derridis Yates.
Micropeltella consimilis Syd.
Micropeltis philippinensis Syd.
Phyllachora ramosii (P. Henn.) Theiss. and Syd.
Phyllachora yapensis (P. Henn.) Syd.

DERRIS DIADELPHA
Meliola abrupta Syd.

DERRIS ELLIPTICA
Auerswaldia derridis Henn.
Phyllachora yapensis (P. Henn.) Syd.

DERRIS HEPTAPHYLA
Asterinella gracilis Syd.

DERRIS PHILIPPINENSIS
Micropeltis sp.
Phyllachora affinis Theiss. and Syd.
Phyllachora yapensis (P. Henn.) var. *rhytismoides* Rehm.

DERRIS ATROVIOLACEA
Asterina trachycarpa Syd.

DERRIS ULIGINOSA
Asterina derridis Henn.

DESMODIUM sp.
Meliola heterocephala Syd.

DESMODIUM GANGETICUM
Meliola desmodii Karst. & Roum.
Meliola parenchymatica Gaillard.

DESMODIUM LAXIFLORUM
Meliola heterocephala Syd.

DESMODIUM PROCUMBENS
Oidium erysiphoides Fr.

DESMODIUM PULCHELLUM
Meliola heterocephala Syd.

DESMODIUM VIRGATUM
Meliola desmodii Karst. & Roum.

DICHAPETALUM sp.
Micropeltella paetensis Syd.

DIGITARIA CONSANGUINEA
Phyllachora graminis (Pers.) Fckl.

DILLENIA sp.
Asterina dilleniae Syd.
Asterina ramosii Yates.
Asterina spissa Syd.

DILLENIA PHILIPPINENSIS
Asterina dilleniae Syd.
Hypocrella melaena Syd.

DINOCHLOA sp.
Physalospora dinochloae Rehm.
Phyllachora tjankorreh Rac.

DINOCHLOA SCANDENS
Coniosporium punctiforme Sacc.
Dimerosporina dinochloae Syd.

EUGENIA sp.
Angatia eugeniae Syd.
Asterina ditissima Syd.
Asterina eugeniae Yates.
Asterina lobata Syd.
Asterina pemphidioides Cke.
Lembosia eugeniae Rehm.
Meliola arborescens Syd.
Metasphaeria incompleta Rehm.
Micropeltis borneensis Syd.
Micropeltella megasperma Syd.
Parasterina pemphidioides Cke.
Phragmothyriella bakeri Henn.

EUGENIA CALOBCOB
Ozonium auricomum Pers.

EUGENIA CUMINGII
Asterina colliculosa Speg.

EUGENIA GLOBOSA
Meliolina arborescens Syd.

EUGENIA JAMBOLANA
Meliola pulcherrima Syd.

EUGENIA INCARNATA
Nematothecium vinosum Syd.

EUGENIA XANTHOPHILLA
Meliolina radians Syd.

EUONYMUS JAVANICA
Micropeltis euonymi Syd.
Microthyriella philippinensis Syd.

EUPHORBIA HETEROPHYLLA
Macrophoma euphorbiae Syd.

EUPHORBIA NERIIFOLIA
Colletotrichum euchroum Syd.

EURYA ACUMINATA
Physalospora euryae (Rac.) v. Hoehn.

EXACUM CHIRONIOIDES
Coleosporium exaci Syd.

EXOCARPUS LATIFOLIUS
Meliola exocarpiae Yates.

F

FAGARA AVICENNAE
Asterina fagariae Yates.

FAGRAEA PHILIPPINENSIS
Meliola fagraeae Syd.

FAGRAEA RACEMOSA
Morenoella fagraeae Syd.

FICUS sp.
Catacauma elmeri Syd.
(*Phyllachora elmeri* Syd.)
Catacauma infectorium (Cke.) Theiss. and Syd.
Meliola umirayensis Yates.
Physalospora ficina Syd.
Phyllachora spinifera (Karst. & Har.) v. Hoehnel.

FICUS APOENSIS
Catacauma apoense Syd.
(*Phyllachora apoense* Syd.)

FICUS BANAHAENSIS
Trabutia elmeri Theiss. & Syd.

FICUS BENGETENSIS
Trabutia bengetensis Yates.

FICUS CAUDATIFOLIA
Dictyothyriella hecterosperma Syd.
Helminthosporium ficuum Yates.
Micropeltis borneensis Syd.

FICUS CARINA
Uredo fici Cast.

FICUS CHRYSOLEPIS
Catacauma circinatum Syd.
(*Phyllachora circinata* Syd.)

FICUS CRASSITORA
Catacauma valsiforme (Rehm) Theiss. and Syd.
(*Phyllachora valsiformis* Rehm.)

FICUS DISTICHA
Lasmenia ficina Syd.

FICUS FLAVO-CORTICA
Catacauma kaernbachii (P. Henn.) Theiss. and Syd.

FICUS GARCIAE
Catacauma garciae Theiss. and Syd.

FICUS GUYERI
Schizochora elmeri Syd.

FICUS HAUILI
Catacauma lagunense Syd.
(*Phyllachora lagunensis* Syd.)

FICUS HETEROPHYLLA
Catacauma sanguineum Syd.
(*Phyllachora circinata* Syd. v. *sanguinea* Rehm.)
Phyllachora kaernbachii Henn.

GMELINA PHILIPPINENSIS
Dimerina graffii Syd.
Meliola micromera Syd.

GONIOTHALAMUS sp.
Didymella orchnodes Rehm.

GONIOTHALAMUS ELMERI
Aecidium parile Syd.
Micropeltis borneensis Syd.

GOSSYPIUM sp.
Colletotrichum gossypii Southw.
Kuehneola gossypii Arth.

GOSSYPIUM BRASILIENSIS
Uredo desmium (B. & Br.) Petch.

GOUANIA MICROCARPA
Meliola araneosa Syd.

GUIOA sp.
Lembosia inconspicua Syd.
Pestalozzia pauciseta Died.

GUIOA PERROTTETII
Helminthosporium reyesii Died.
Meliola cylindrospora Rehm.
Micropeltis sp.

GYMNOSPORIA SPINOSA
Meliola gymnosporae Syd.

GYMNOSTACHYUM SUBCORDATUM
Puccinia leiochroma Syd.

H

HELICTERES HIRSUTA
Cercospora helicteris Syd.

HELIOTROPIUM INDICUM
Oidium erysiphoides Fr.

HELMINTHOSTACHYUM ZEYLANICUM
Cercospora helminthostachyus P. Henn.

HETEROSTEMMA ANGUSTILOBUM
Asterina escharioides Syd.

HEVEA BRAZILIENSIS
Guignardia heveae Syd.
Helminthosporium heveae Petch.
Phythophthora faberi Maubl.

HEWITTIA sp.
Uromyces hewittiae Syd.

HEWITTIA SUBLOBATA
Meliola hewittiae Rehm.
Meliola quadrispina Rac.
Uromyces hewittiae Syd.

HEYNEA SUMATRANA
Asterina opposita Syd.

HIBISCUS TILIACEUS
Phyllachora minuta P. Henn.

HIPPOCRATEACEAE
Meliola oligomera Syd.

HOMALIUM sp.
Stigmatea philippinensis Yates.

HOMALONEMA sp.
Mycosphaerella alocasiae Syd.

HOMALONEMA PHILIPPINENSIS
Cercospora extremorum Syd.
Micropeltis sp.

HOMONOIA RIPARIA
Meliola ramosi Syd.

HOPEA sp.
Meliola hopeae Yates.

HOPEA PIERREI
Actinothyrium hopeae Graff.

HOPEA PLAGATA
Pycnocarpon fimbriatum Syd.

HOYA sp.
Gloeosporium hoyae Syd.
Hysterium hoyae Henn.
Physalospora hoyae Syd.

HOYA LUZONICA
Guignardia albicans Rehm.
Micropeltella coerulescens Rehm.
Meliola hoyae Syd.
(*Micropeltis albo-marginale* Speg.)

HYDNOCARPUS SUBFALCATUS
Asterinella hydnocarpiae Yates.

HYGROPHILA SALICIFOLIA
Uredo hygrophilae Syd.

HYMENOLEPIS sp.
Stigmatidothis palawanensis Syd.

HYMENOLEPIS SPICATA
Parmularia hymenolepidis Henn.

HYPOESTIS sp.
Puccinia mesomorpha Syd.

HYPTIS SPICIGERA
Puccinia hyptidis (Curt.) T. & E.

HYPTIS SUAVEOLENS
Meliola hyptidis Syd.

LEPISANTHES SCHIZOLEPIS
Meliola lepisantheae Sacc.
Microthyriella philippinensis Syd.

LEPISTEMON FLAVESCENS
Aecidium kaernbachii P. Henn.

LEUCAS sp.
Septoria bakeri Syd.

LEUCAS LAVANDULIFOLIA
Septoria bakeri Syd.

LEUCOSYKE sp.
Aschersonia confluens P. Henn.

LEUCOSYKE CAPITELLATA
Helminthosporium leucosykeae Yates.
Meliola leucosykeae Yates.

LICUALA SPINOSA
Cercospora licualae Syd.

LINOCIERA sp.
Meliola tayabensis Yates.

LINOCIERA RAMIFLORA
Meliola linocierae Syd.

LITSEA sp.
Asterina litseae Yates.
Lembosia nervisequia Syd.
Meliola litseae Yates.

LITSEA CAESIFOLIA
Septobasidium molliusculum Syd.

LITSEA GLUTINOSA
Asterina litsea Yates.
Cercospora litseae-glutinosae Syd.
Gnomonia litseae Syd.
Meliola cookeana Speg. v. *saccardoi* Syd.
Ozonium auricomum Pers.
Pestalozzia gibberosa Sacc.
Pestalozzia pauciseta Sacc.
Venturia litseae Syd.

LITSEA PERROTTETII
Asterina litseae Yates.
Helminthosporium maculosum Sacc.
Meliola bidentata Cooke.
Meliola cookeana Speg. v. *saccardoi* Syd.
Meliola litsea Syd.

LITSEA TAYABENSIS
Phyllachora lepida Syd.

LIVISTONA sp.
Graphiola cylindrospora Syd.
Meliola livistoniae Yates.
Oxydothis livistonae Syd.

LOBELIA NICOTIANAEFOLIA
Coleosporium campanulae (Pers.) Lev.

LOPHATHERUM GRACILE
Dimerosporina pusilla Syd.

LOPHOPETALUM TOXICUM
Asterina lophopetali Rehm.
Micropeltella schmidtiana (Rost.) Rehm.
Morenoella lophopetali (Rehm.) Theiss.

LORANTHUS sp.
Loranthomyces sordidulus (Lev.) v. Hoehn.
Melasmia exigua Syd.
Meliola catugigensis Yates.

LORANTHUS HAENKEANUS
Loranthomyces sordidulus (Lev.) v. Hoehn.

LORANTHUS LEYTENSIS
Asterinella loranthi Syd.

LORANTHUS PENTAGONUS
Sympeltis loranthi Syd.

LUFFA CYLINDRICA
Asterina simillima Syd.
Plasmopara cubensis (B. & C.) Humphrey
Irene confragosa Syd.

LUMNITZERA RACEMOSA
Meliola pelliculosa Syd.

LUNASIA AMARA
Meliola patens Syd.

LYCOPERSICUM ESCULENTUM
Pythium debaryanum Hesse.

LYGODIUM FLEXUOSUM
Mycosphaerella ditissima Syd.

M

MACARANGA sp.
Brachysporium bakeri Syd.
Lambro insignis Rac.
Limacinula biseptata Sacc.
Meliola macarangae Syd.
Phyllachora macarangae Henn.
Marsonia pavonina Syd.

MELIOLA VILIS
Coryne meliolicola (Henn.) v. Hoehn.
Spegazzinia meliolae A. Zimm.

MELIOSMA *sp.*
Phacospora meliosmae Kusano.

MELODORUM sp.
Balladyna melodori Syd.

MELOTHRIA MUCRONATA
Puccinia melothriicola Syd.

MEMECYLON sp.
Aschersonia sp.
Chaetoplaca memecyli Syd.
Meliola affinis Syd.

MEMECYLON LANCEOLATUM
Coccomyces memecyli Syd.
Dictyothyrium giganteum Syd.
Meliola memecyli Syd.
Micropeltella clavispora Syd.
Micropeltella memecyli Syd.
Morenoella memecyli Syd.

MEMECYLON SUBFURFURACEUM
Morenoella memecyli Syd.

MENISPERMACEAE
Meliola banguiensis Yates.

MERREMIA sp.
Meliola ipomoeae Rehm.

MERREMIA HASTATA
Meliola merremiae Rehm.

MERREMIA HEDERACEA
Meliola merremiae Rehm.

MERREMIA NYMPHAEIFOLIA
Meliola merremiae Rehm.

MERREMIA UMBELLATA
Aecidium kaernbachii P. Henn.
Meliola forbesii Gaill.
Meliola quadrispina Rac.
Puccinia convovuli (Pers.) Cast.

MERREMIA VITIFOLIA
Aecidium kaernbachii P. Henn.
Meliola merremiae Rehm.

MICRODESMIS CASEARIFOLIA
Asterinella ramuligera Syd.

MILLETTIA sp.
Meliola bataanensis Syd.
Meliola millettiae Yates.
Phyllachora luzonensis Henn.

MILLETTIA CAVITENSIS
Phyllachora luzonensis Henn.

MILLETTIA MERRILLII
Phyllachora luzonensis Henn.

MISCANTHUS sp.
Ustilago kusanoi Syd.

MISCANTHUS JAPONICUS
Pleospora miscanthiae Yates.

MISCANTHUS SINENSIS
Phyllachora miscanthi Syd.

MISCHOCARPUS sp.
Aschersonia macularis Syd.

MISCHOCARPUS FUSCESCENS
Microthyrium mischocarpi Syd.

MITRAGYNA ROTUNDIFOLIA
Meliola mitragynes Syd.

MOMORDICA CHARANTIA
Asterina momordicae Yates.
Dimerium tayabensis Yates.
Plasmopara cubensis (B. & C.) Humphrey

MORINDA sp.
Balladynopsis philippinensis Theiss. and Syd.

MORINDA BARTLINGII
Meliola palawanensis Syd.

MORINDA BRACTEATA
Aspergillus flavus (de Bary) Bref.

MORUS ALBA
Aecidium mori Barcl.
Kuehneola fici (Cast.) Butl.
Phyllactinia corylea (Pers.) Kast.
Phyllactinia suffulta (Rabent.) Sacc.

MUCUNA LYONI
Uromyces mucunae Rabh.

MUSA CAVENDISHII
Mycosphaerella musae Speg.

MUSA SAPIENTUM
Gloeosporium musarum C. & M.
Macrophoma musae (Cke.) Berl. & Vlg.
Mycosphaerella musae Speg.

MUSA TEXILIS
Mycosphaerella musae Speg.

MUSSAENDA PHILIPPICA
Meliola mussaendae Syd.
Spegazziana meliolae A. Zimm.

PANDANUS SABOTAN
Diplodia fructus-pandani Henn. f. *foliorum* Sacc.
Linospora pandani Rehm.
Neopeckia diffusa (Schw.) Sacc. var. *magnifica* Rehm.

PANDANUS TECTORIUS
Aulacostroma palawanense Syd.

PANDANUS UTILISSIMUS
Linospora pandani Syd.

PANDANUS VEITCHII
Colletotrichum pandani Syd.

PANICUM sp.
Meliola panici Earle.
Spegazzinia meliolae A. Zimm.
Ustilago manilensis Syd.
Ustilago panici-miliacei (Pers.) Wint.

PANICUM AURITUM
Ustilaginoidea ochracea P. Henn.

PANICUM CARINATUM
Balansia claviceps Speg.
Balansia thanatophora (Lev.) v. Hoehn.
Phyllachora congruens Rehm.

PANICUM FLAVIDUM
Uromyces linearis B. & Br.

PANICUM PALMAEFOLIUM
Meliola panicicola Syd.
Phyllachora graminis (Pers.) Fckl. f. *panici* (Schw.) Shear.
Phyllachora seriata Theiss. and Syd.

PANICUM PATENS
Phyllachora stenospora (B. & Br.) Sacc.

PANICUM PILIPES
Hypocrella pulvinulus (B. & Br.) Sacc.
Meliola panicicola Syd.

PANICUM REPENS
Uromyces linearis B. & Br.

PARALSTONIA CLUSIACEA
Meliola laevigata Syd.

PARASHOREA PLICATA
Asterina camarinensis Syd.
Asterina shoreana Sacc.
Pycnocarpon parashoreae Syd.

PARINARIUM CORYMBOSUM
Pycnocarpon nodulosum Syd.

PARKIA ROXBURGII
Phyllachora parkiae Henn.

PARKIA SHERFESSEI
Micropeltella agusanensis Syd.

PARKIA TIMORIANA
Melanconium parkiae Syd.
Phyllachora parkiae Henn.

PASPALUM sp.
Chaetostroma cladosporioides Sacc.
Telimena graminella Syd.

PASPALUM SCROBICULATUM
Uredo paspalina Syd.

PAVETTIA sp.
Lembosia pavettiae Theiss.

PAYENA LEERII
Phaeosaccardinula ficina Theiss. and Syd.

PERICAMPYLUS sp.
Mycosphaerella pericampyli Syd.

PERICAMPYLUS GLAUCUS
Mycosphaerella pericampyli Syd.

PERSEA PYRIFORMIS
Meliola acutisecta Syd.

PHAEANTHUS EBRACTEOLATUS
Ypsilonia cuspidata Lev.

PHASEOLUS sp.
Pleosphaerulina phaseoli Syd.
Uredo vignae Bres.

PHASEOLUS CALCARATUS
Phyllachora phaseolina Syd.

PHASEOLUS LUNATUS
Cercospora lussoniensis Sacc.
Cladosporium herbarum (Pers.) Link.
Diplodia phaseolina Sacc.

PHASEOLUS MUNGO
Uromyces appendiculatus (Pers.) Link.

PHASEOLUS AUREUS
Cercospora cruenta Sacc.

PHOLIDOTA IMBRICATA
Colletotrichum orchidearum Allesch.

PHRAGMITIS sp.
Meliola dichotoma Berk. & Cke.

PHRAGMITIS KARKA
Meliola dichotoma Berk. & Cke.

SCHIZOSTACHYUM sp.
Aschersonia badia Pat.
Aschersonia confluens P. Henn.
Aschersonia microspora Sacc.
Balladyna uncinatus Syd.
Hypocrella schizostachyi P. Henn.
Hypocrella vilis Syd.
Micropeltella schmidtiana (Rost.) Rehm.
Pycnoderma bambusina Syd.
Rosellinia crustacea Rehm.
Rosellinia rachidis Rehm.
Scirrhia luzonensis Henn.
Telimena bakeri Syd.

SCHIZOSTACHYUM DIFFUSUM
Ozonium glumicola Sacc.
Phyllachora shiraiana Syd.
Scirrhia bambusina Pers.
Theissenula clavispora Syd.

SCHIZOSTACHYUM LONGISPICULATUM
Stella disseminata Syd.

SCOLOPIA sp.
Asterina cylindrophora Syd.

SCIRPUS GROSSUS
Cercospora uredinophylla Sacc.
Meliola intricata Syd.

SCLERIA sp.
Gibberella creberrima Syd.

SEMECARPUS CUNEIFORMIS
Micropeltella schmidtiana (Rost.) Rehm.
Micropeltis semecarpi Syd.
Pseudomeliola placida Syd.

SESAMUM ORIENTALE
Cercospora sesami A. Zimm.

SETARIA ITALICA
Uromyces setariae-italicae (Diet.) Yoshino.

SHOREA POLYSPERMA
Asterinella luzonensis Syd.
Morenoella bakeri Syd.

SCHOENUS APOGON
Phyllachora schoenicola Syd.

SIDA ACUTA
Meliola sidae Rehm.

SIDA CARPINIFOLIA
Meliola sidae Rehm.

SIDA JAVENSIS
Meliola sidae Rehm.
Oospora hyalinula Sacc.
Puccinia heterospora B. & C.

SIDA MYSORENSIS
Meliola sidae Rehm.
Puccinia heterospora B. & C.

SIDA VERONICAEFOLIA
Puccinia heterospora B. & C.

SIDEROXYLON APOENSE
Asterina laxiuscula Syd.

SIPHONODON CELASTRINEUS
Phyllosticta siphonodontis Sacc.

SMILAX sp.
Puccinia citrina Syd.

SMILAX BRACTEATA
Puccinia merrillii P. Henn.

SMILAX CHINENSE
Puccinia smilacis-chinae P. Henn.

SMILAX LATIFOLIA
Puccinia merrillii P. Henn.

SOLANUM sp. (Wild.)
Cercospora tosensis P. Henn.

SOLANUM MANUCALING
Asterina diaphana Syd.

SOLANUM MELONGENA
Cercospora melongenae Welles.
Gloeosporium melongenae Sacc.
Phyllosticta hortorum Speg.

SOLANUM TUBEROSUM
Alternaria solani (E. & M.) Sorauer.
Phytophthora infestans (Mont.) de Bary.

SPATHOGLOTTIS CHRYSANTHA
Coleosporium merrillii Henn.

SPATHOLOBUS APOENSIS
Periaster spatholobi Syd.

SPATHOLOBUS GYROCARPUS
Epiphyma mucunae (Rac.) Syd.
Litsea spatholobi Rehm.

SPHENOCLEA ZEYLANICA
Cercosporidium helleri Earle.

SPINIFEX SQUARROSUS
Tilletia opaca Syd.

SPOROBOLUS sp.
Phyllachora sporoboli Pat.

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PLATE I. BATANGAS BULL IN THE LAST STAGES OF ANAPLASMOSIS. LIPA, BATANGAS.

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ILLUSTRATION

A BRIEF HISTORY OF RINDERPEST IN THE PHILIPPINE ISLANDS

By STANTON YOUNGBERG, D.V.M., *Chief Veterinarian, Bureau of Agriculture*

Rinderpest in the Philippine Islands is of comparatively recent origin, particularly so when compared with the nearby countries on the Continent of Asia where it has been present since time immemorial. It was first introduced into these Islands in the eighties of the last century. It is generally believed that this occurred in the year 1886 or 1887, though several people staunchly assert that it was as early as 1882. From what can be determined at the present time, it appears that the introduction was by means of carabaos imported from French Indo-China that were intended for breeding purposes. It seems very likely that the governmental authorities in the Philippine Islands at that time were unacquainted with the disease and, therefore, not conversant with the precautions necessary to be taken in the importation of animals from disease-infected countries. Once the disease had gained entrance, it spread to most parts of the Philippine Islands and caused a terrible loss of cattle and carabaos. In many places this loss was as high as 90 per cent. In the year 1891, the American Consul at Manila, in a report to the State Department at Washington, made mention of the large numbers of animals that had succumbed to a disease which he states was called "Epizoötia." From the description that he gave, it can easily be recognized as rinderpest. It does not appear that the Government at that time took any decided steps to keep the disease under control.

Nothing of particular interest in regard to the disease is again found until the years 1900–1, when the military authorities took note of a severe epizoötic of rinderpest that was devastating the herds of many sections of the Islands at that time. It appears that during those years many provinces lost from 50 to 60 per cent of their cattle and carabaos. The Census of 1903, reports that 629,176 cattle and carabaos died of the disease in 1901 and 1902. Filipinos who remember those days very well have informed me that this second devastating outbreak was almost coincident with the outbreak of the Spanish American War in 1898. This is indeed very probable. It was then ten

years since the first great epizoötic and during that time new generations of susceptible animals had been born which, greatly outnumbering the old survivors, constituted enough material for another epizoötic.

Upon the establishment of Civil Government in the Philippine Islands, the control of contagious animal diseases was given to the Bureau of Health. There being no veterinarians in the Philippine Islands a few men were brought over from the United States. The Board of Health, as it was then called, was organized August 7, 1901. It appears that during the later part of 1901 and the first part of 1902 the glycerinated-bile method of producing immunity was tried to a limited extent. The available records indicate that only about 3,000 heads were injected. A serum laboratory was started by the Board of Health and the production of anti-rinderpest serum was begun in August, 1902. On January 30, 1903, this laboratory was transferred to the recently organized Bureau of Government Laboratories. Until March 1, 1904, a few field veterinarians were under the direction of the serum laboratory. On that date the veterinary corps of the Board of Health was recognized and all the veterinarians transferred to it. The method adopted for the control of rinderpest upon the establisment of the serum laboratory was the simultaneous inoculation of the cattle and carabaos in the infected areas, with the object in view of conferring a permanent immunity against the disease. The serum was sent out to the field from the serum laboratory in Manila. The virulent blood, however, was drawn from animals sick with rinderpest that the veterinarian might find in the infected district. A small dose of this virulent blood was injected into the animals to be immunized, as well as what was calculated to be done of serum sufficiently large to protect the animals against a severe attack.

Unfortunately, this method did not produce the satisfactory results that had been expected; the losses in many places were very heavy and the people became antagonistic toward the work, and consequently it had to be abandoned. It is evident that the animals were not always kept tied up, carefully watched and temperatures taken during the critical period of reaction, but were left to the care of their respective owners. Furthermore, the method of obtaining the virulent blood did not insure a strain of virus of uniform virulence. At times the virus obtained would be very low in virulence and at other times highly virulent, depending upon the stage of the disease at which the blood was drawn. Furthermore, it does not appear that sufficient cognizance was taken of the fact that there is great varia-

tion in susceptibility to rinderpest of animals not only in different parts of the Archipelago, but also in different parts of the same province. If a standard strain of virus, against which the serum had been tested in the laboratory, had been employed, there is no doubt but that better results would have been obtained. Also, there is no doubt but that the method of obtaining virulent blood resulted in the transmission of other diseases, such as surra, which naturally contributed toward an increased mortality.

In the latter part of 1905, the Veterinary Division was transferred from the Bureau of Health to the Bureau of Agriculture, and on January 1, 1907, the serum laboratory was transferred to this Bureau from the Bureau of Science. The simultaneous inoculation method having been abandoned, the policy was now adopted of endeavoring to control rinderpest by the employment of the serum-alone method, that is, the injection of the animals in the infected areas with anti-rinderpest serum. This is the method that has been employed by British veterinarians in India for several years. It has worked out fairly well in that country, which, however, is due mainly to the fact that the majority of the cattle there have naturally such a very high resistance against rinderpest that only a very small amount of serum is needed to protect them or carry them through a modified attack of the disease. The animals in the Philippine Islands are much more susceptible to rinderpest, and this is particularly true of the carabao. Where an Indian animal would require only 20 or 30 cc. of serum the susceptible Philippine animal requires 10 to 15 times that amount.

The Bureau of Agriculture at that time did not have a sufficient force of veterinarians to attend to all the rinderpest outbreaks throughout the Philippine Islands. When the writer arrived in August, 1907, there were then only 7 veterinarians employed in this Bureau. Furthermore, there was no adequate law providing for the isolation and quarantine of infected animals and infected municipalities and provinces. Considering the susceptibility of Philippine animals to rinderpest, the natural consequence was that in a virulent outbreak the disease would spread faster than anti-rinderpest serum could be prepared and injected. In October, 1907, the Philippine Commission approved Act No. 1760, which, among other things, provided for the isolation and quarantine of infected animals and infected districts. A beginning was then made toward acquainting the local officials and people with the necessary quarantine measures to be adopted upon the appearance of rinderpest in any barrio or municipality. For the psychological effect on

the people it is essential that violators of the quarantine regulations be brought to trial and punished as soon as possible after committing the offense. Provincial Boards and Municipal Councils were, therefore, urged to adopt local animal-quarantine ordinances providing penalties and making it possible to try the offenders in the local justice of the peace courts. Still the employment of anti-rinderpest serum continued to be the mainstay of the rinderpest campaigns.

Cattle have been imported into the Philippine Islands since the early days of American occupation owing to the shortage of animals caused by the previous disastrous epizoötics of rinderpest. At the time the writer arrived in the Islands, Hongkong was the main source of supply. There was then no animal quarantine station and the imported cattle were confined in private corrals scattered throughout Manila, which were improperly located and did not serve the purpose of a quarantine station. It was of course to be expected that, under such conditions, the importation of animals from disease-infected countries would be the cause of the further introduction of infection. The Director of Agriculture at that time made a valiant fight for an appropriation to construct an animal quarantine station and was finally successful. The construction of the Pandacan Quarantine Station was begun in 1909. By the later part of 1910 work had progressed far enough to allow of its being used for some lots of imported animals. Most of the work as planned was finished in 1911, but in reality left only an incompletely constructed station. It should have been surrounded by a stone wall from the beginning; this, however, was not done and thus leaves a doubt in the minds of many people as to whether or not infection might escape.

In 1910, the Bureau of Agriculture was transferred from the Department of the Interior to the Department of Public Instruction. Dr. A. R. Ward was appointed Chief Veterinarian and additional veterinarians from the United States were also employed until in 1911 there were 41 in the service of this Bureau. By that time, the fact had become pretty well recognized among the veterinarians that the use of serum alone as the principal means of combating rinderpest would not insure the eradication of rinderpest from the Islands, nor even its efficient control. It was seen that the period of immunity conferred by anti-rinderpest serum was entirely too short. It produces only a temporary passive immunity which lasts only as long as it is circulating throughout the animal's system. When it has been eliminated from the body, which occurs in

from 7 to 14 days, the animal is again susceptible to rinderpest. The average dose of anti-rinderpest serum then employed was 50 cc. There is no doubt but that in many cases this dose was too small when one takes into account the susceptibility of the native animals. Had larger doses been employed results in many individual cases would undoubtedly have been better, but the object sought, the eradication of rinderpest, could not have been accomplished by this method alone.

The plan of concentrating on the enforcement of proper quarantine and sanitary measures was then adopted. The use of serum was gradually abandoned, until finally the serum laboratory was closed. Arrangements were made with the military authorities for the employment of a large force of Philippine Scouts in coöperation with the Bureau of Agriculture for the enforcement of strict quarantine in campaigns progressively covering entire provinces. The policy adopted was that of a pogressive search of territory for rinderpest with concentrated forces of scouts and Bureau employees. The Philippine Constabulary also rendered assistance in the handling of smaller and isolated outbreaks. At one time there were on this duty 30 officers and 1,390 enlisted men belonging to 13 companies of the Philippine Scouts. The Philippine Constabulary in addition often had as high as 250 men detailed on rinderpest quarantine duty.

The intensive campaigns on which Philippine Scouts were employed were begun in the month of May, 1911, in the Province of Pangasinan, the northernmost province of the large valley of central Luzon and also the most important rice producing section of the Islands. With several companies of scouts and a sufficient personnel of Bureau veterinarians and inspectors, a definite number of municipalities, the number of which had been calculated in advance, were simultaneously occupied on a certain date. All the animals in the barrios of these occupied municipalities were placed in quarantine and the animals tied up for a 15-day period. During this time a complete census was taken of all cattle and carabaos and a careful inspection made for the presence of rinderpest. After the centers of infection in these municipalities had been located, sufficient forces to enforce the quarantine in these infected places were left behind and the rest of the forces moved on to other municipalities. In this manner during 1911 and 1912 the campaign progressed successively through the Provinces of Pangasinan, Nueva Ecija, Tarlac, Bulacan, Pampanga, Zambales, Bataan, Rizal, and Laguna. Scout forces were also employed on quaran-

tine duty on the Island of Siquijor and in the Provinces of Iloilo, Cebu, and Occidental Negros. In the later part of 1912 and most of 1913 the searching campaign was carried on along the northwest coast of Luzon in the Provinces of La Union, Amburayan, Ilocos Sur, Abra, and Ilocos Norte.

There is no doubt but that in the main these campaigns were efficiently conducted. However, it was a new thing to the people and met with a great deal of popular opposition. Many people considered the quarantine campaigns to be worse than the disease itself, as they naturally caused some hardships and inconvenience. The main point of weakness of these extensive campaigns was in our opinion the failure to take fully into account the fact that rinderpest had been established in the Philippine Islands for so many years that it had become enzoötic in many sections. This being the case, it was therefore impossible to completely eradicate rinderpest in any province in one grand campaign of relatively short duration. In places where rinderpest is enzoötic animals pass through an attack of the disease in such mild form that it is frequently exceedingly difficult, for even a veterinarian with a great deal of experience, to arrive at a positive diagnosis. The disease is also transmitted to hogs, goats, and sheep as well as the wild deer and hogs. It is, therefore, easy to see that since rinderpest can attack so many different species of animals it can go on in a mild form in some particular locality for several months without causing enough damage to excite suspicion. This therefore was the cause of the re-infection of those provinces that had apparently been freed from rinderpest during those strictly enforced quarantine compaigns.

The Philippine Islands is practically an unfenced country and the animals are not stabled as they are in the temperate zone. Cattle, carabaos, hogs, goats, and sheep run loose a great deal of the time and pick up their own living. After plowing in the field for a couple of hours, the farmer will unhitch his carabao and turn it loose to graze. Such conditions of course make it possible for rinderpest to be transmitted in mild form for a considerable length of time until conditions are favorable for a more or less severe epitzoötic. The beasts of burden in this country are the carabao and cattle. Products are frequently hauled to market by bull-carts for distances up to 50 or 60 kilometers. A strain of rinderpest virus that may be carried on in mild form in one locality may prove more virulent

to the animals of other localities. Each year at the height of the crop-moving season outbreaks always occur along the main traveled highways, for which the bull-cart animals are responsible.

In this country the severe epizoötics come in cycles of from 8 to 10 years. The first introduction was in 1887. The next big wave, according to the most reliable information obtainable, got under way in 1897. The third epizoötic was well started when the writer arrived in 1907. In 1916 the increasing death rate in provinces where the disease had been running a fairly mild course for several years gave indication that another big wave was forming.

At the time the extensive rinderpest campaigns were inaugurated, the Bureau of Agriculture also entered upon a campaign for the prohibition of the importation of animals from foreign countries infected with rinderpest and foot and mouth disease. The men in charge at that time were of the opinion that this importation was one of the principal causes for the existence of rinderpest in the Philippine Islands. The campaign for the prohibition of cattle importation had various vicissitudes and was strenuously combated from many sides. Finally General Orders were issued providing for a 90-day quarantine on all animals imported from countries known to be infected with rinderpest. General Order No. 18 providing for the 90-day quarantine on cattle and carabaos coming from Hongkong was promulgated December 10, 1910. The order covering French Indo-China (General Order No. 8, series 1911–12) was not, however, issued till June 25, 1912. This of course was in effect the same as absolute prohibition. This measure was bitterly fought by the people of Occidental Negros who demanded Indo-Chinese carabaos for work purposes, and also by a large part of the population of Manila, as they considered that it interfered with their supply of fresh beef. To palliate the measure as far as the people of Manila were concerned, a quarantine station with slaugtherhouse was established at Sisiman for the slaugther of animals imported from Australia. These animals could not be handled at Pandacan as they are wild range cattle and are also infected with a disease called "contagious Bovine Pleuropneumonia" which is not present in the Philippine Islands. During the year 1913, the pressure from Occidental Negros for the importation of Indo-Chinese carabaos became so strong that the Bureau of Agriculture constructed a quarantine and

immunizing station at Lapus-Lapus, Iloilo, and the importation of carabaos from French Indo-China was resumed subject to simultaneous inoculation against rinderpest.

During the year 1911, the classical method of combating rinderpest by the slaughter of infected and exposed animals was attempted but very soon abandoned. It was tried in La Union, Siquijor, Surigao, and Rizal provinces. One of the principal causes of failure was the great sentimental attachment of the Filipino farmer for his carabaos. Even though the animals were desperately ill, the majority of the people much preferred to have them die a natural death instead of being destroyed, and this in spite of the fact that they were being reimbursed their full value. We have seen grown men weep bitterly when their sick animals were taken out and shot. In order to avoid the killing of their infected animals as well as the quarantine of the exposed, but to them apparently harmless individuals, the people began hiding them out much more than they normally would. It soon became plain that this method was therefore of but little assistance in the control of rinderpest and was accordingly abandoned.

Two provinces, Cavite and Bataan, were turned over to the Executive Secretary in 1911 for the eradication of rinderpest with no other assistance than that afforded by the local officials. This was done at his request to demonstrate whether rinderpest could be controlled by the local officials and people themselves without the intervention of Bureau and Scout or Constabulary forces. These provinces had passed through a severe rinderpest outbreak during the previous two years and the infection present at that time was only the tail-end of this outbreak. In the course of a few months the disease entered upon its quiescent period and the people connected with the rinderpest campaign were led to believe that the disease had been eradicated. However, a few months later, rinderpest again appeared in those provinces. In other words, it had been carried on in a very mild form among the more resistant animals until it finally attacked some of the more susceptible individuals.

The people throughout the provinces began to murmur against the quarantine campaigns as enforced by the Philippine Scouts in coöperation with the Bureau of Agriculture, and many of them had no hesitancy in stating that they wanted this system done away with and were willing to take chances on their animals contracting rinderpest. Many governors and other elective officers were elected on the platform of entirely doing away with rinderpest quarantines. This opposition finally cul-

minated in the passage by the Philippine Legislature in December, 1913, of Act No. 2303 which transferred the control of the rinderpest campaigns from the Bureau of Agriculture to the provincial governors. This Act only empowered the Bureau of Agriculture to issue the necessary rules and regulations, and it devolved upon the provincial governors to enforce them. We knew what the inevitable result would be. The people did not want to be troubled with animal quarantines and it was therefore impossible to expect the provincial governors to run counter to the desires of their constituents and enforce measures which were not popular. Many of our veterinarians became discouraged and left the Islands; by the end of the year 1914 the number of veterinarians connected with this Bureau had dropped to 19.

In June 1914, the writer was appointed to the position of Chief Veterinarian. Upon assuming the duties of the office we endeavored to impress upon the Government the fact that the problem of eradicating rinderpest in these Islands is a very difficult and complicated one, and was at that time rendered more difficult by the frame of mind in which the people and their representatives and officials then found themselves. It was also rather unfortunate that during previous years the idea had been allowed to become disseminated that the eradication of rinderpest was possible in the not distant future. As far as the control of rinderpest by the local authorities was concerned, the only thing that could be done was to let them go ahead and find out by experiences what a difficult problem they were tackling. We have always helped them to the utmost of our resources and in fact have always done more than is required of us by Act No. 2303.

Experience has demonstrated that when rinderpest has spread universally in a country destitute of fenced enclosures in which herd mingles with herd in the most perfect freedom, its eradication by the ordinary quarantine and sanitary measures is exceedingly difficult. This office, therefore, adopted a policy of gradually introducing the immunization of cattle and carabaos by means of simultaneous inoculation into those places where the attitude of the people and their officials was favorable. The governor of the Province of Pampanga at that time, was the Honorable, Honorio Ventura, and in him we found a staunch believer in and supporter of this policy. Accordingly immunizing stations were established in the Province of Pampanga and the simultaneous inoculation of animals began there on a fairly large scale. At first there was considerable opposition from many people, but by tact and diplomacy and the governor's un-

failing patience, this was gradually overcome and the work proceeded in a pretty satisfactory manner. The majority of the animals in that province have been immunized and in consequence rinderpest is now a negligible factor in a place where it was formerly continuously present and a source of a great deal of trouble to all concerned. The people seeing the results have become convinced of the efficiency of this method and we now encounter no opposition in our work in that province.

The size of the stations varies with the number of animals in the district to be immunized. Ordinarily they are constructed so as to accommodate on an average of 100 head per week. Upon arrival at the station, the animals are simultaneously inoculated with virus and anti-rinderpest serum and are retained there until the end of the immunizing period, which is ordinarily 3 weeks. Temperatures are taken twice daily and the animals carefully observed, and in case of necessity, additional serum is injected to control the severity of the reaction. After an animal has reacted, it is kept in the station for another week and carefully attended to in order to insure proper convalescence. When ready for release, a few liters of blood are drawn from the jugular vein for the production of anti-rinderpest serum to be used for the injection of other animals. By this method, the cost of anti-rinderpest serum for simultaneous inoculation is reduced to a minimum. The immunizing stations are not always able to produce sufficient serum for their own use and then the supply must be supplemented from our serum laboratory at Pandacan. The animal is given a distinctive brand and the owner is given a certificate of immunization certifying that his animal has been immunized against rinderpest and is then allowed to go home. Immunized animals are not subjected to quarantines in areas infected with rinderpest. Upon arrival at the immunizing stations, the owner of the animal pays a fee of ₱3 per head, which goes into the provincial immunizing fund to reimburse the province for the construction and maintenance of the stations, as well as reimbursing the owners of animals that may die during the process. The mortality has been very light, averaging on the whole, a little more than 2 per cent. The owner has to bear the expense of the care and feed of his animals while in the station. One drawback to the work is the fact that it takes on an average of 3 weeks to immunize an animal and this does not always meet with the favor of everyone, particularly in those places where the immunizing process is a new thing to the people. However, the people in many

sections of the Islands are becoming convinced of the efficacy of the immunization and we have had requests for the establishment of stations from several provinces, which, unfortunately, we have not always been able to attend to, owing to the lack of funds for this work.

For several years we have worked on the theory that it might be possible to develop and perfect an anti-rinderpest vaccine. Research along this line has been carefully and painstakingly carried on at our veterinary research laboratory and our efforts appear not to have been in vain. A vaccine has been developed and has been employed upon thousands of animals in the field and has given results that have exceeded our expectation. This work is still in its infancy but, if properly supported by the Government, will eventually be one of our principal weapons in the control and final eradication of rinderpest. The undersigned does not contend that the vaccine has been absolutely perfected but we are of the opinion that eventually we will be able to make it as nearly perfect as anything along that line can be. The use of vaccine has a great advantage over the simultaneous inoculation method, in that it does not necessitate tying up the animals and taking them away from productive labor for a period of three weeks. An animal can be injected and immediately thereafter put right to work. We are not prepared to state as yet how long a period of immunity is conferred, as the work is still too young for any definite statements in that regard. Our experience up to date, however, indicates that it confers an immunity of several months duration.

Anti-rinderpest serum, which has been much maligned and the use of which was discontinued in 1911, is again being employed as an aid in the control of rinderpest. It is not, however, distributed gratis, but is sold at or near the cost of production. The largest users have been the sugar haciendas in Occidental Negros and Iloilo. Also at times it is sold at half price to the poorer people. It is now used principally in those places where cases of rinderpest have recently appeared or in which infection is imminent. Serum confers a passive immunity effective within a few hours after injection. Vaccine on the other hand produces a "negative phase" for a few days after injection, during which the animal is very susceptible to infection. It is, therefore, often dangerous to use vaccine in badly infected places; in such places serum, when employed by one who knows his business, can be used with good results. When employed on animals which are not close to injection the results are not always as good. The

serum is eliminated from the body of the animal in from 10 to 15 days, at the end of which time it is again susceptible to rinderpest and will contract it if exposed.

The people are gradually becoming convinced that the control of rinderpest cannot be properly handled by the local officials. This is proven by the fact that their representatives have, for the last 2 years, been talking about turning back the control to the Director of Agriculture, and now have finally presented a bill in the Legislature to that effect. When approved, as it eventually must be, this will put the direction back where it belongs and enable the central Government to more effectively coördinate the various means at its disposal for the control of rinderpest.

One important point must be borne in mind, and that is, that no method has yet been devised that will do away with the necessity of isolating and quarantining the sick and exposed animals, and it is doubtful if any such method can be devised. It is true that if the Government would furnish this Division with enough money to prepare enormous quantities of vaccine and serum and a very large force of men to inject the same all over the Philippine Islands, the necessity of enforcing quarantines would be reduced to a minimum. However, as things stand at present, with the relatively small amount of money allotted for veterinary work, it is essential that the spread of rinderpest be controlled as much as possible by efficient quarantines and the vaccine and serum be then judiciously employed to further assist in keeping the disease under control.

With the change of administration in 1914, the pressure on the Government to allow the importation of Indo-Chinese and Chinese cattle both for work and beef purposes increased. That year also witnessed the outbreak of the Great War and one of its first consequences was an embargo on the exportation of foodstuffs from Autralia. Owing to threatened shortage of meat due to that embargo, the Government decided to again permit the importation of Asiatic cattle for slaughter. The imported cattle upon arrival are unloaded into lighters and taken directly from the steamer to the Pandacan Quarantine Station. The animals to be used for beef purposes are slaughtered there. Those that are to be sold for work purposes are immunized against rinderpest by simultaneous inoculation before being released form the station.

During the years 1916–17–18, when there was a scarcity of vessels due to the war, a relatively small number of animals were imported, the numbers being respectively 8,361, 5,640, and 2,226.

In those years correspondingly, larger numbers of native cattle were slaughtered. Thousands which from their size and quality of beef are not worth more than from ₱40 to ₱60 sold for from ₱100 to as high as ₱150. Due to the high prices many good work cattle which should have been conserved for agricultural purposes were also slaughtered; also large numbers of females were slaughtered, and a high percentage of these were heavy with calf when killed.

The consumption of beef in Manila has increased greatly during the last two years. The average daily kill of cattle at the two slaughterhouses is 96 heads. The average daily kill for the 4 previous years was 62 head.

At the present time the Philippine Islands is practically an unfenced country, which, as has been noted, is a most favorable condition for the spread of contagious animal diseases. We are of the opinion that the time has now arrived when the Government could seriously consider the matter of the adoption of a compulsory fencing law applicable both to farms and cattle ranches.

The important rôle played by the deer and particularly the wild hogs in the keeping alive and transmission of rinderpest must be more definitely recognized. There should be no "close season" on the hunting of deer, and it would also be advisable to consider the granting of small bounties to encourage the destruction of wild hogs in those provinces where they are plentiful and therefore a constant menace to the live-stock industry.

Europe was infected with rinderpest for centuries and made no great progress in its eradication until the governments adopted and energetically applied the method of slaughtering all sick and exposed animals. Unfortunately conditions are such that this system can not now be applied in the Philippine Islands. That the disease in this country may be more efficiently kept under control it is essential that the responsibility for this work be delegated to one central authority and the various methods for rinderpest eradication applicable to conditions here be thus more effectively coördinated.

FURTHER NOTES ON ANAPLASMOSIS IN CATTLE IN THE PHILIPPINE ISLANDS

By WILLIAM HUTCHINS BOYNTON, D.V.M., *Pathologist, Bureau of Agriculture*

During the year 1915 three cases of what appeared to be anaplasmosis in cattle occurred at the Veterinary Research Laboratory, Pandacan, Manila. The results of a study of these animals was published in *The Philippine Journal of Science* in 1917.[1]

Since the publication of the above mentioned article, this disease has made its appearance on three different occasions in a rather pronounced form, and has proved to us quite conclusively that the disease anaplasmosis does exist in cattle in the Philippines.

We have learned that great care has to be exercised in the immunization stations where cattle are immunized against rinderpest by the simultaneous method. By this method anti-rinderpest serum and virulent rinderpest blood are simultaneously given. The animals develop a mild form of rinderpest and upon recovery they possess a substantial form of immunity against that disease. The danger of this method lies in the fact that the animals which are used for virulent blood purposes may harbor the anaplasma organism. With our present knowledge of that disease it is practically impossible to tell if an animal has had a previous attack of anaplasmosis. The organisms are only readily detected under the microscope when the animal is in the height of the disease. As soon as the temperature subsides to normal the anaplasma begin to disappear from the circulating blood and are soon so few in number that it is difficult to find them. When blood from such an animal is injected into a susceptible animal there are great possibilities that the susceptible animal will develop anaplasmosis after an incubation period varying from 20 to 35 days, usually in the neighborhood of 25 days.

The first report of a disease which resembled anaplasmosis in an immunization station was made during the latter part of 1917. Dr. P. H. Burnett was immunizing cattle on Mindoro Island. After the animals had passed through the rinderpest

[1] Boynton, William Hutchins. A Disease in Cattle in the Philippine Islands, Similar to that Caused by Anaplasma Marginale, Theilor. *The Philippine Journal of Science* (1917), Vol. XII, No. 6. Sec. B. pp. 281–291. 3 plates.

immunization and had been released, there came in reports after two or three weeks that several of the animals became very weak and died. Dr. Burnett immediately made an investigation, and from the symptoms and autopsy reports he submitted it is quite evident that these animals were suffering from anaplasmosis. We did not obtain any blood preparations for examination at the laboratory to prove conclusively the existence of this disease.

Following are extracts from Dr. Burnett's notes. "Few animals found dead in pasture, others down and unable to get up. Some very weak but still able to walk. Trembling by the muscles of the fore and hind legs, staggering gate when urged to walk. Some animals appeared to be very sleepy, heavy sonorous breathing, feces small hard pellets, in many cases covered with mucous. The prostrate animals as a rule had a subnormal temperature varying between 36°C., 34°C. and as low as 33°C. just prior to death. Some of the animals which were still able to stand had temperatures of over 40°C. When the animals went down they did not appear to be suffering from any pain but were too weak to stand. Refused food and water."

Autopsy reports gave the following general picture: "No rinderpest lesions could be detected. Muscle tissue very pale in appearance. Fat around kidneys and intestines marked yellow color. Liver somewhat enlarged and streaked with yellow in some cases and in others yellow throughout, gall bladder distended with either a thick yellow or green vile. Heart filled with dark blood clot, large intestines contained hard feces covered with mucous."

From the above symptoms and lesions we have a very good picture of animals suffering and dying of anaplasmosis. This disease made its first appearance about 28 days after the virulent blood injection.

The second outbreak of anaplasmosis which came to our notice was in animals which had been immunized by the simultaneous method in the immunization station at Lipa, Batangas Province, during July and August, 1920. Dr. C. H. Leavitt was in charge. Dr. Youngberg, Chief Veterinarian of the Bureau of Agriculture, made a full report of this outbreak to the Secretary of Agriculture, which can be obtained from the Bureau of Agriculture files.

The outbreak in Lipa gave us further opportunity to make a closer study of this disease. Dr. Youngberg, Dr. Kern, and the writer made several trips to Lipa, to assist Dr. Leavitt in diagnosis, autopsies, and treatment.

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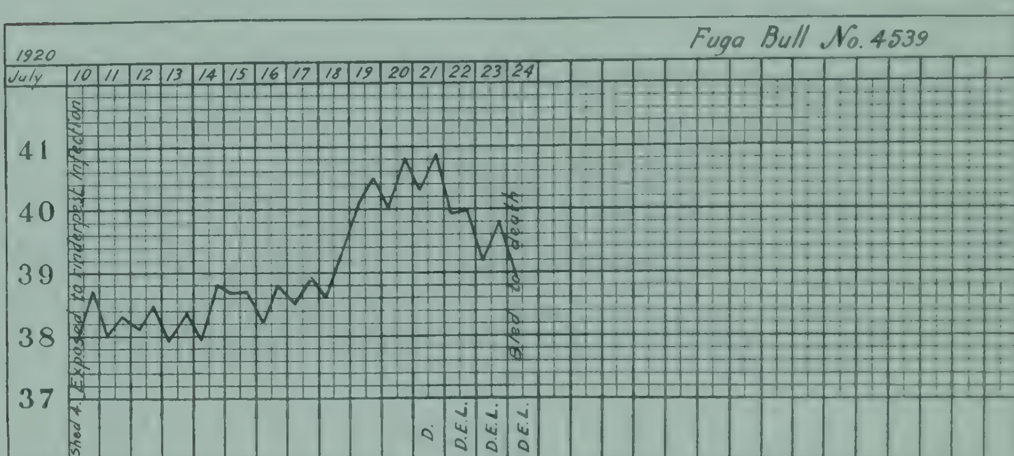
Four different lots of animals were infected with anaplasmosis from this station. On account of the long incubation period of this disease, it was not recognized until after a large number of animals had been immunized. All the animals which became sick and which died belonging to Lots Nos. 4, 6, and 7 were released from the immunization station. Lot No. 8 was in the station being immunized when anaplasmosis was discovered in the released animals.

LOT NO. 4

Lot No. 4 consisted of 49 head of cattle and one carabao. July 30, 1920, they were each given 10 cc. of virulent blood from Fuga Bull No. 4539 and 400 cc. of anti-rinderpest serum. Seven of these animals passed through a good rinderpest reaction. On August 14th all the animals that did not react were each given 15 cc. of virulent blood from Carabao 407. On August 21st all of these animals were released from the immunization station.



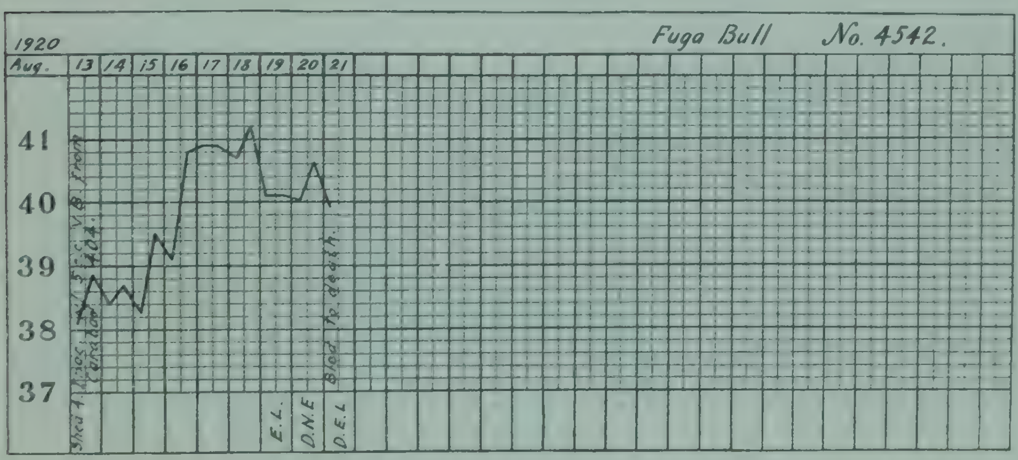
The first intimation of trouble came on September 5th when one of the immunized aminals died. This was 37 days after it had received the virulent blood from Fuga Bull No. 4539. Of this lot seven animals died after they were released. All the animals which became sick and died of this lot were cattle. The general symptoms as obtained by questioning the owners of these animals was, marked weakness, refused food, constipation, feces covered with mucous.

LOT NO. 6

Lot No. 6 consisted of 40 head of cattle and 10 head of carabao. They were each given 15 cc. of virulent blood from Carabao No. 404 on August 13, 1920, and from 400 to 600 cc. of anti-rinderpest serum depending on the size of the animal. Eighteen animals gave good rinderpest reactions. On August

23d the animals which did not react were given 10 cc. each of virulent blood from Fuga Bull No. 4542. On September 1, 1920, all these animals were released from the immunization station.

The first intimation of trouble came on September 24th, this was 42 days after receiving the first injection of virulent blood from Carabao 404 and 32 days after receiving the virulent blood from Fuga Bull No. 4542. Of this lot, 9 animals died after they were released. The only animals affected were cattle which had received the second injection of virulent blood from Fuga Bull No. 4542. The cattle which received but one injection of virulent blood from Carabao 404 and the ten carabaos, all of which received a double injection of virulent blood, remained well.

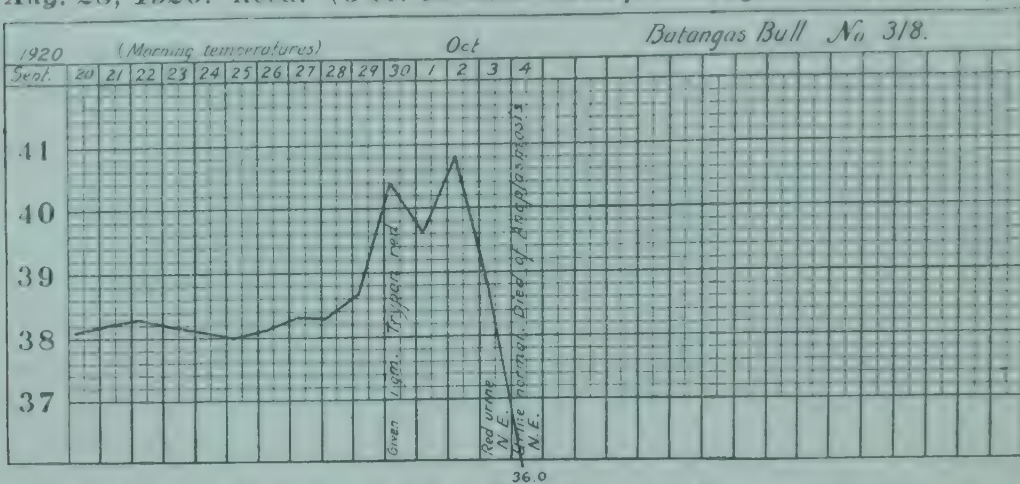


From all appearance the cattle became infected with anaplasma upon the administration of the second virulent blood from Fuga Bull No. 4542. The incubation period symptoms and death of these nine animals varied from 32 to 39 days. The last death occurred on October 1, 1920.

LOT NO. 7

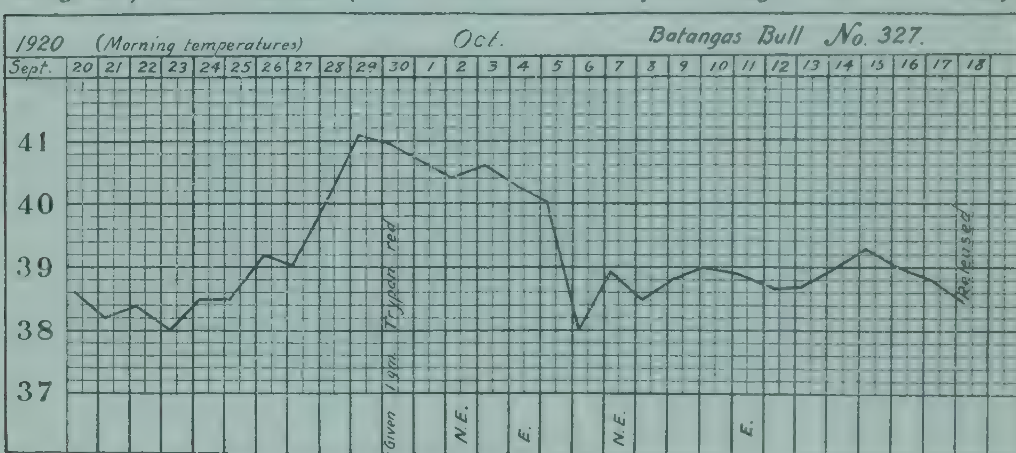
Lot No. 7 consisted of 48 head of cattle and 7 head of carabao. They were each given 10 cc. of virulent blood from Fuga Bull No. 4542 on August 20, 1920, and from 300 to 600 cc. of anti-rinderpest serum depending upon the size of the animal. Twenty-three of these animals gave good rinderpest reaction. On August 31st all the animals which did not react were given 15 cc. each of mixed virulent blood from Fuga Bulls Nos. 4553 and 4554. A few of these animals were released on September 3d, 1920, but the greater majority on September 10th.

Aug. 28, 1920. Recd. (5 cc. virulent blood from Fuga Bull No. 4542)



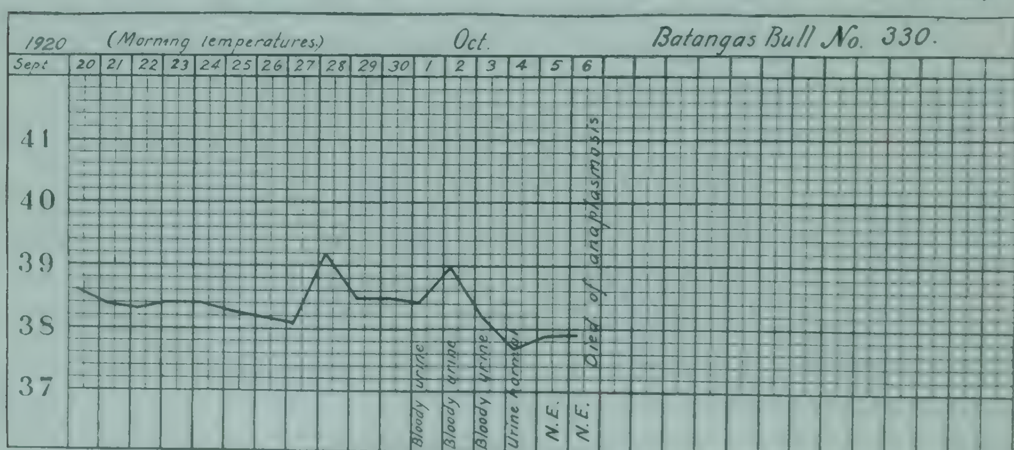
Batangas Bull No. 318 ran a rapid and rather characteristic fatal course. The red urine was caused by the injection of trypan red.

Aug. 28, 1920. Recd. (5 cc. virulent blood from Fuga Bull No. 4542)



Batangas Bull No. 327 ran a high continuous temperature for ten days and made a recovery.

Aug. 28, 1920. Recd. (5 cc. virulent blood from Fuga Bull No. 4542)



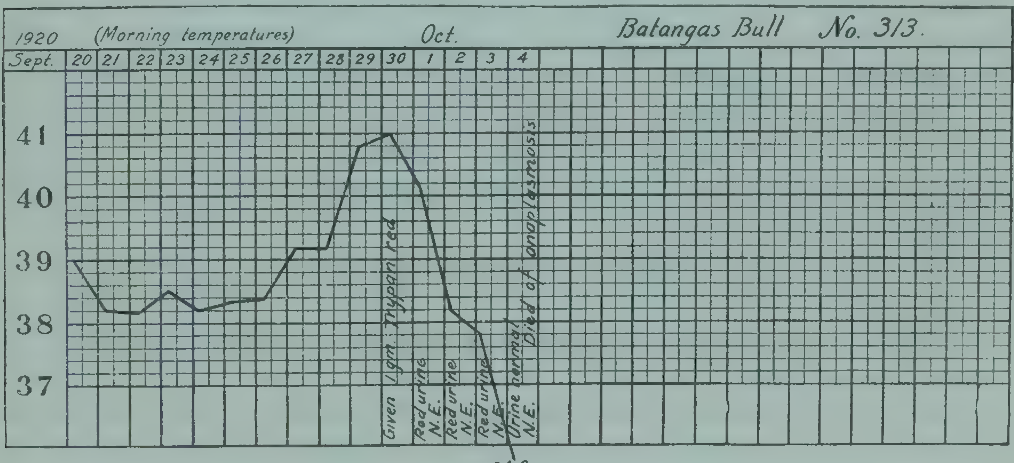
Batangas Bull No. 330 ran a slightly prolonged course of the disease and never presented a very high temperature. This was one of the few cases which developed bloody urine. The urine became normal in appearance three days before death.

The first report of trouble came on September 19th, which was 30 days after the blood of Fuga Bull No. 4542 had been injected into them. Of this lot, nine animals died varying from 30 to 36 days after receiving the virulent blood from Fuga Bull No. 4542. All of the seven head of carabao remained well although they received a double injection of virulent blood. It is quite evident that the cattle became infected with the first injection of virulent blood.

LOT NO. 8

Lot No. 8 consisted of 39 head of cattle and 11 head of carabao. They were each given 5 cc. of virulent blood from Fuga Bull No. 4542 on August 28, 1920, and from 350 to 550 cc. of anti-rinderpest serum depending upon the size of the animal. None of these animals gave a rinderpest reaction. On September 7th they were each given 15 cc. of virulent tissue extract

Aug. 28, 1920. Recd. (5 cc. virulent blood from Fuga Bull No. 4542)



Batangas Bull No. 313 ran a rapid and fatal course. The red urine was caused by the injection of trypan red.

and 150 cc. of anti-rinderpest serum. September 27th the eleven carabaos were released from the station but the cattle were held. One carabao of this lot died on October 4, 1920, but undoubtedly not from rinderpest or anaplasmosis. The exact cause of death was not ascertained.

Fifteen of the cattles which were held in the immunization station died, varying from 32 to 47 days after receiving the virulent blood from Fuga Bull No. 4542.

By holding the cattle of Lot No. 8 in the immunization station we were able to observe them during the course of the disease. Of the 39 head of cattle all of them became sick of which 15 died. The others recovered after a few days of illness except in a few cases where recovery was not complete until after two weeks.

SYMPTOMS OF THE ANIMALS RETAINED IN THE LIPA IMMUNIZATION STATION

The first symptom was a rise in temperature. In a few instances the morning temperature went up to 41° C., but the majority of them ranged between 40° C. and 40.7° C. In one fatal case the morning temperature was never over 39.2° C. Three of the cases were noticed to have blood in the urine which lasted from one to three days after which the urine became normal in color.

Soon after the rise in temperature the animals would become languid. Their coat would loose its gloss and the flies would congregate on them. As the disease progressed the animals became drowsy and weak. In some instances they would prop themselves up against the stall and spread their legs out to keep from falling over. In fatal cases they usually stopped eating two or three days before death. They would finally become so weak they could not stand. Their breathing became laboured and sonorous. Very little response when urged to get up. They showed no symptoms of severe pain. The principal symptom was extreme weakness. Usually when an animal went down, it would live from 12 to 18 hours. Constipation was generally present and the feces was in the majority of cases coated with mucous.

AUTOPSY

Several animals were autopsied by the writer. The general picture is as follows:

The subcutaneous tissue and fat over a greater portion of the body took on a lemon yellow and in some instances almost an orange or golden color. The blood as a rule was anemic in appearance. The lungs show no pneumonic lesions but in some instances took on a light lemon yellow color. The fat on the heart was usually of a lemon yellow or orange color. The liver in a few instances was practically a solid yellow color, in others it presented large yellow streaks and blotches. On cutting into the tissue of the liver this coloration extended into the depths of the organ. The gall bladder in one instance was enormously enlarged. As a rule it was from two to three times its normal size and usually filled with thick jam like greenish or yellow bile, in one or two instances the bile was watery but contained a large number of flakes. The fat around the stomach, intestines, and kidneys was usually a lemon yellow or golden orange color. The spleen was very slightly enlarged and the pulp in some instances was a little softer and jam like than normal. In some instances the kidneys had light blotchey patches on them.

The mesenteric lymphatics in some cases showed slight oedema.

The stomach and small intestines did not present any marked abnormality.

The colon and rectum in many instances contain hard fecal pellets which were in the majority of cases covered with mucous.

There was considerable mucous clinging to the walls of these canals.

The general appearance was that of a marked jaundice.

BLOOD EXAMINATION

Blood smeer preparations were stained with Giemsa, many animals gave very good pictures of the anaplasma marginale type. As high as five and six anaplasma have been found in one red blood corpuscle. As a rule one organism was present in a corpuscle. However, in a great many instances two organisms were present. Where this condition occurred, the two bodies were either close together or one on either side of the corpuscle. A considerable number of bodies were also noticed undergoing what appeared to be division. These anaplasma bodies were most abundant while the animal was in the height of its fever, a few days after the fever subsided the bodies became very scarce and hard to find.

Three animals presented blood pictures of a severe grade of anemia. There were numerous nucleated red blood corpuscles, most of them of the normoblast type, a few microblasts were also found, and some piokilocytosis.

The following notes will give some idea of the best stage of the disease to make blood examinations.

The blood preparations were made October 10th.

Bull No. 321 first rise in temperate October 1st. Anaplasma very scarce, few found. This animal recovered.

Bull No. 347. High temperature for 20 days. Many nucleated red corpuscles mostly normocytes. This animal recovered.

Bull No. 326. Normal temperature five days. Bad odor. Few nucleated red corpuscles. Many polynuclear leucocytes. Anaplasma very few. This animal died on October 13th.

Bull No. 340. First rise in temperature October 5th. Bloody urine October 7th. Urine clear on October 10th when blood smeer was taken. Anaplasma very plentiful. This animal recovered.

Bull No. 351. First rise in temperature October 2nd. Blood in urine October 7th. Urine normal in color October 9th. Few anaplasma were found. This animal recovered.

Bull No. 345. First rise in temperature October 6th. Anaplasma very plentiful. This animal recovered.

Bull No. 343. First rise in temperature October 3rd. Anaplasma very few. This animal recovered.

Bull No. 338. Freekish temperature. High one day and down the next. Nucleated red corpuscles present. Anaplasma could not be definitely located. A few points were found which had a questionable appearance. This animal recovered.

Bull No. 333. First rise in temperature October 1st. Anaplasma very few, hard to find. This animal recovered.

MEDICAL TREATMENT

September 30, 1920, Dr. Youngberg and the writer went to Lipa and administered Trypan Red and Medicinal Methylene blue to some of the sick animals.

Twelve sick animals were each given intravenously 1 gramme of trypan red dissolved in 200 cc. of sterile physiological salt solution.

One sick animal was given intravenously 1 gramme of medicinal methylene blue dissolved in 200 cc. of sterile physiological salt solution.

One sick animal was given intravenously a mixture of 0.5 gramme of trypan red and 0.5 gramme medicinal methylene blue dissolved in 200 cc. of sterile physiological salt solution.

Of these 14 animals treated, 8 died, varying from four to thirteen days after the administration of the drugs. All of the animals that died received trypan red. Undoubtedly the six animals which recovered after the treatment would have made a recovery without any treatment.

October 10, 1920, we tried "Flavasol," a patent medicine with a cure all reputation, on three animals.

We administered 150 cc. of this drug intravenously to two animals and 100 cc. to the third.

None of these animals died, but it did not appear to change the course of the disease and undoubtedly the animals would have made a recovery without any treatment.

THE THIRD OUTBREAK of anaplasmosis which came to our notice was in some cows which were imported from Tsingtao, China. These animals were immunized by the simultaneous method against rinderpest, in the Quarantine Station at Pandacan, Manila.

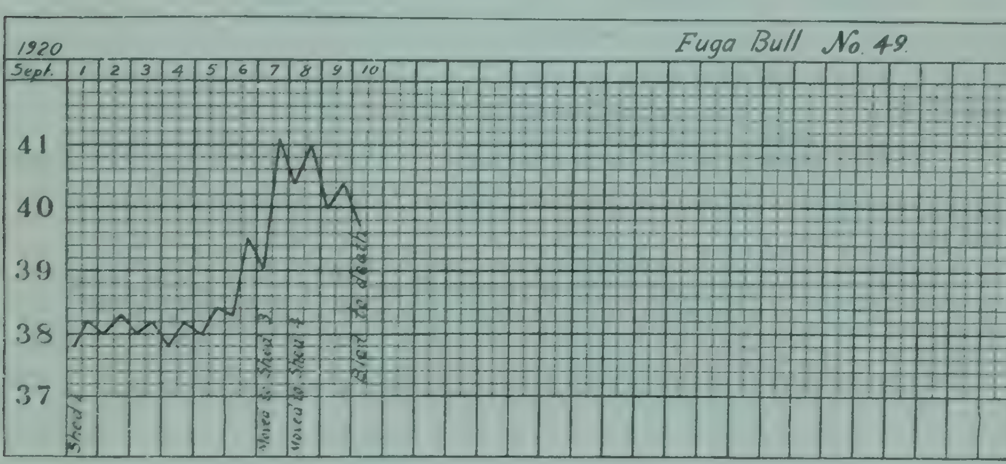
July 11, 1921, these animals were each given 500 cc. antirinderpest serum and 10 cc. of a mixture of virulent rinderpest blood from Fuga Bulls Nos. 4638 and 4639.

July 25th, these animals were each given 25 cc. of virulent rinderpest blood from Fuga Bull No. 49.

These animals passed through their rinderpest immunization and were released from the Quarantine Station August 8, 1921.

Six of the animals were taken to a place not far from Manila. On August 25th, a report came to the laboratory that these six animals were suffering from a peculiar sickness. This was 45 days after the first virulent blood injection and 31 days after the second virus injection. The writer called for some blood smeer preparations. The blood specimens were received August 30th. Stained with Giemsa and presented very good pictures of anaplasmosis. It was reported that four of the six animals died of a severe jaundice. Their fat and internal organs were lemon yellow and the gall bladder was distended with thick green bile.

It is very evident from the blood examination and report on the autopsy that these animals were suffering from and died



of anaplasmosis. Judging from the incubation period these animals must have picked up the infection from the second virulent blood injection taken from Fuga Bull No. 49.

The writer has immunized a considerable number of dairy cows imported from Australia and also a few cattle imported from the United States against rinderpest by the vaccine method. Two weeks after the vaccination they have been given virulent rinderpest blood to test their immunity. Care has been taken to use carabao virulent blood on this type of animal and we have never had any trouble with anaplasmosis.

CONCLUSIONS

1. From our observations and study of animal diseases it is very evident that anaplasmosis in cattle exists in the Philippine Islands.

2. Anaplasmosis was found present in Batanes cattle in 1915 [1] and it is quite conclusive that the blood from Fuga cattle caused the disease at Lipa during 1920, and also that the blood from Fuga cattle caused the disease in Tsingtao animals in 1921.

3. From the results obtained in the immunization stations there is strong evidence that carabaos have a natural immunity to anaplasmosis.

4. From our results in treatment of anaplasmosis with trypan red, medicinal methylene blue, and Flavasol, little can be said. Much more work will have to be done along this line, before anything definite can be stated.

5. The general symptoms of anaplasmosis in cattle are marked weakness, severe anemia, and usually pronounced jaundice.

6. Animals recovering from anaplasmosis are apparently carriers of this disease. When their blood is injected into a susceptible animal there are great possibilities that the susceptible animal will contract the disease.

7. The incubation period is rather long, averaging about 25 days to the first rise in temperature after the injection of infected blood.

8. From our observations at the Veterinary Research Laboratory, it is quite evident that carabaos are not carriers of anaplasma.

9. With our present knowledge, animals which are being immunized against rinderpest in very light tick infested areas, such as that in the neighborhood of Lipa, Batangas Province, and all animals imported from Northern China, America, Australia, and all localities where anaplasmosis is not known, should have carabao virulent blood used on them, and not cattle blood.

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[1] Boynton, William Hutchins. A Disease in Cattle in the Philippine Islands Similar to that Caused by Anaplasma Marginale, Theilor.

The Philippine Journal of Science (1917), Vol. XII, No. 6. Sec. B. pp. 281–291. 3 plates.

THE MANUFACTURE OF ANTI-RINDERPEST SERUM IN THE PHILIPPINE ISLANDS

By Teodulo Topacio, D.V.M., *In charge, Serum Laboratory, Pandacan*

In the manufacture of a given biological product it is not enough that it should serve the purposes for which it is intended. The process must be practical, economical, and efficient. The same applies to the production of anti-rinderpest serum.

In the Philippines there are two standard ways of preparing this anti-serum. One by the so-called hyperimmunization and the other by simultaneous immunization. The serum prepared from the first method is termed hyperimmune serum, the other reactor serum.

PREPARATION OF HYPERIMMUNE SERUM

The method of preparing this serum is rather a slow and complicated process. Cattle are first subjected to simultaneous inoculation with rinderpest virus and serum in varying amounts depending upon the relative susceptibility of the animals to be used. From five to fifteen cubic centimeters (5 to 15 cc.) of rinderpest virus and 50 to 400 cc. of serum are injected simultaneously. When the animals have completely recovered from the reaction and their temperatures returned to normal, this is followed by a second injection of virus at the rate of 25 cc. per animal. This is repeated a week or ten days later with a dose of 100 cc. each. A week after, the animals are given 500 cc. of virus apiece, and at the end of another week the last massive injection of virus is given at the rate of 2,500 to 3,500 cc. to the animal. This operation is repeated after a week and the animals are then allowed seven days in which to recuperate. Then, one more dose of virus is given at the rate of 1,000 cc. per animal and after another week the animals are bled for serum three times, one week apart. The amount of blood drawn at each bleeding from each animal will depend upon its size and condition. The animals thus bled are either turned to the pasture to recuperate and may be subjected to another routine treatment or may be sent to be abattoir for beef.

Previously the serum thus obtained was centrifuged and then passed thru filter before it was bottled. Possibly this was done to insure the keeping qualities of the serum by eliminating most of the solids present and also to secure an attractive appearance by making it clear before leaving the laboratory. It has been determined, however, that all this could be dispensed with by simply filtering the serum thru double sterile gauze and allowing it to settle three or four days before bottling. This simple method when properly handled had given satisfaction in our hands. Either 0.5 per cent phenol or 0.1 per cent formaline solution is used as preservative.

From the foregoing, it will be noted that even by omitting the second series of virus injections, the length of time necessary to prepare serum by this method can not be made less than forty (40) days. This in itself does not constitute a very serious objection, but when we consider the enormous quantity of fresh virus required by this process before an animal becomes available for serum, it must be admitted that the heavy drain on the country's supply of susceptible animals that naturally follows would threaten the very life of this method. In his studies in British India, Holmes(1) says on this point. "(* * *). During the year 1908 and 1910 some 2,500 hill cattle were used up anually. This expenditure of animals at one time threatened to exhaust the supply of susceptible hill cattle and to bring rinderpest serum preparation to a close" (* * *). This country had the same problem to contend with, hence, attempts had been advanced to solve this difficulty. Thus, Ruediguer(2) used peritoneal injections of normal salt solution allowing it to remain for 2 hours before bleeding the virus animal to death and then aspirating it. Thomson(3) used the same solution peritoneally a short time before bleeding the animal to death. More recently Boynton(4) had obtained a filtrate of extracts prepared from the organs of a Batanes bull (virus animal) after bleeding the animal to death for virus. The total virulent material obtained from this animal was 9 liters of virulent blood and 11 liters of the filtrate. He states further that by combining this method with that of Martoglio's, the total output of virus from this one animal would reach 26,300 cubic centimeters or three times as much as ordinarily provided the animal had only been bled to death. Even with this combined method only a few animals could be hyperimunized with the total virus obtained from one animal and again the problem of animal expenditure remains only partly solved.

PREPARATION OF REACTOR SERUM

The production of anti-rinderpest serum from animals that have recovered from reaction by simultaneous inoculation was the logical result of the expensive process of hyperimunization. From the year 1919 to date, the Philippine Government had had an exceptional opportunity to prepare serum by this method. Arrangement had been made with the importers of cattle from Pnom Penh, Indo-China to have several hundred heads of each shipment undergo simultaneous immunization for serum purposes while the animals were being kept under quarantine and before they were sent to the abattoir at the Pandacan Quarantine Station, Manila. In the last three years up to the present, this Government had depended on these animals almost exclusively for its supply of anti-rinderpest serum and thus far, the results from the use of this serum had been satisfactory.

One or two days after arrival the animals to be used for serum work are injected simultaneously 50 cc. of cattle reactor serum and 10 to 25 cc. virulent blood per animal. Temperatures are taken twice daily and carefully recorded in charts prepared for the purpose. At the end of the reaction, the animals that have recovered are selected and allowed to recuperate. An animal must have shown definite clinical symptoms or a febrile reaction consisting of 39.5° C.–40° C. and above for three or four days consecutively before it could be considered a reactor. The percentage of reaction ranges from 20 per cent to 50 per cent while the percentage of death oscillates between 0.1 per cent to 4 per cent. The Pnom Penh cattle are peculiarly fit for this work as they are larger in size and much less susceptible to rinderpest than the native cattle.

Seven days after reaction when their temperatures have returned to normal the reactors are bled 3 liters each. Three days after this, they are bled to death for serum and their carcass sent to the abattoir for beef. It will be observed that the length of time required in the operation is but 20 to 25 days, as compared with hyperimmunization. The average reactor produces 2,000 to 4,000 cc. of serum with the two bleedings. At this rate the Government serum laboratory had been making an average annual output from 4,000 to 5,000 liters. If the work accomplished in the two other private serum laboratories under Government supervision were to be added, the total annual output of serum in this country would be approximately 6,700 liters. The serum thus obtained is passed thru a double gauze filter into sterile demijohns and the preservative

is added (0.1 per cent Formalin). The serum is allowed to settle several days and is bottled by siphoning from the demijohns. It is then packed up in boxes and stored away in the cold storage. Kept in this condition it will preserve for months or even years.

In contrast with hyperimmunization the advantages of this method are self evident. At the standard dose of 10 cc. to 25 cc. of virus per injection, the virulent blood from a given virus animal will suffice to immunize several hundred serum animals, hence, it is more economical. Another advantage is the rapidity with which serum is prepared by this method. The comparative potency of the two kinds of antisera will be dealt with accordingly.

EFFICIENCY OF HYPERIMMUNE SERUM

To test the efficiency of hyperimmune serum from cattle and carabaos, Ward and Wood(5) had made exhaustive studies on this point in a series of eleven experiments at the Government Laboratory in 1912. They found that (1) injections of this serum in cattle and carabaos at the rate of 20 cc. to 100 cc. per 100 kilos body weight did not cause delay in the appearance of symptoms when the animals were exposed to natural infection. (2) Injecting the same amounts every one to ten days merely modified somewhat the course of the disease. They concluded, therefore, that serum used alone would not prevent infection with rinderpest. These conclusions were supported by official reports and observations from veterinarians who were at the time using serum alone method in the field.

The experience in this country in the last five or six years seems to coincide with these general deductions. Some pertinent remarks may be added, however. It was noticed that in places where the type of infection was mild as in the Ilocos provinces and the central provinces of Luzon, serum alone seemed to have given a fair result provided it was not used on contacts. A dose of 100 cc. to 300 cc. had been used on carabaos. On the other hand it did not seem to effect the spread of infection, for most of the animals so treated would again remain susceptible two weeks after injection. With a virulent type of infection serum alone in small doses seemed to stimulate the severity of the symptoms. The disastrous failure of this method in the Province of Occidental Negros in 1910 where a good number of the animals so treated succumbed to the disease is a concrete instance of its inefficiency as a general field measure.

In the year 1917 the writer had occasion to test cattle hyperimmune and reactor serum while immunizing carabaos with the

simultaneous method at the Lubao Immunization Station, Pampanga. A lot of 56 carabaos were admitted to the station. The animals were segregated into two groups according to size and age. The first group was given 300 to 500 cc. hyperimmune cattle serum per animal and 10 cc. of virus, while the second group received 300 to 500 cc. of carabao reactor serum per animal and 10 cc. of virus. Four animals reacted in group 1, three of which had received 300 cc. and 1 had received 500 cc. The first three showed only febrile reaction. In group 2, five animals had reacted, 3 had received 300 cc. reactor serum, and 2 had received 500 cc. Two animals that had received 300 cc. reactor serum showed very good clinical symptoms and one that had received a 500 cc. dose also manifested clinical symptoms. The rest merely showed high temperatures. All the animals that reacted in both groups were controlled with 300 cc. hyperimmune and reactor serum respectively every two days. The character of the symptoms manifested by the reacting animals in both groups could not be actually differentiated, with the exception that one reacting animal in group 1 showed the most severe attack. All the reactors recovered. Two things might be deduced from this test. (1) There was practically no difference between the two sera. (2) Cattle serum used on carabaos did not seem to give uniform protection.

In October 1918, Mr. Lichauco (cattle importer) had received a shipment of 45 head of Pnom Penh carabaos from Indo-China. Two days after arrival at the Pandacan Quarantine Station they were given simultaneous inoculation, again using cattle hyperimmune serum and carabao reactor serum. These animals averaged 800 to 1,150 lbs. live weight. A brief sketch of this may be appreciated by studying the following table:

Group No.	Number of animals inoculated	Virulent blood	Serum used		Number reacted	Death
			Kind	Amount		
1	27	10 cc.	Cattle hyperimmune	900 cc.	11	2
2	10	10 cc.	Reactor	900 cc.	4	1
3	8	10 cc.	Mixed	900 cc.	4	None
4	1	10 cc.	Reactor	1,000 cc.		

Comparing the results recorded in the above table it will be observed that group 1 had the severest reaction and in group 2 the reaction was not so violent, while in group 3 the reaction was mild. The animal that had received 1,000 cc. did not even show any reaction. From these results it may be inferred that (1) there was no appreciable difference in the behavior of the two kinds of sera. (2) The high percentage of reaction was

probably due either to the weakened sera from age or to the higher susceptibility of this particular shipment of carabaos.

A test was made on the hyperimmune cattle serum received from Harbin, Manchuria, and cattle reactor serum made by the writer in the laboratory. Six young Batangas cattle weighing 220 to 250 pounds were selected for this test. Cattle numbers 2092, 2093, and 2094 were given 150 cc. Harbin hypered serum and 15 cc. virulent blood and cattle numbers 2095, 2096, and 2097 were injected with cattle reactor serum and the same amount of virus. There was no reaction in any of the six animals. They were subsequently given 25 cc. virus a week after and still no reaction followed. These animals being susceptible, the assumption is that there was no perceptible difference in the efficiency of the two sera.

Another test in the efficiency of hypered cattle serum was made on serum received from The Anticattle Plague Laboratory at Tsinan, China. Two native carabaos numbers 251 and 252 were inoculated at Candaba Immunization Station, Pampanga, by Dr. Chas. H. Leavitt October 21, 1921. Carabao 251 was 15 years old and received 250 cc. of this serum and 30 cc. virus, carabao 252 was 2 years and 8 months old and received the same amount of serum and virus, respectively. The latter animal had a severe reaction while carabao 251 remained healthy. After a week number 251 was tested with 25 cc. virus and did not react. This result indicates that this particular serum should be given in liberal amounts in carabaos to secure the desired degree of protection in simultaneous immunization.

EFFICIENCY OF REACTOR SERUM

To test the potency of cattle reactor serum prepared in the laboratory ten highly susceptible native cattle from Dalupiri Island were submitted to simultaneous immunization. These animals weighed around 450–600 lbs. All were given from 500 to 600 cc. reactor serum and 15 cc. virulent blood. Only one out of ten showed good reaction. After a week the other 9 animals were tested with 25 cc. virus and they all remained healthy. The result points to the fact that native susceptible cattle may be given uniform protection by using 500 cc. fresh reactor serum. With imported breeds of cattle from countries where rinderpest is not present the amount of serum necessary to confer protection is indeed large. In 4 Australian milk cows that had been immunized with simultaneous method at the laboratory in Pandacan 1,000 cc. reactor serum was used at

the initial injection. All showed fever reaction and necessitated further large injections of serum to control their temperature.

Similarly cattle reactor serum was tested on highly susceptible native carabaos. Four animals from the Island of Catanduanes weighing about 800 lbs. each were injected 800 cc. of reactor serum and 15 cc. virus apiece. One animal came down with a severe reaction, but recovered. This animal was supported by periodical injections of serum every other day which amounted to $1\frac{1}{2}$ liters in all. The rest of the 4 animals showed a temperature reaction which required subsequent injections of serum as before. From the results in these four animals, it is believed that when cattle reactor serum is employed in immunizing carabaos it should be given in liberal quantities. The experience in the Government immunizing stations in the last few years seems to corroborate these results. When reactor serum prepared from carabaos at the stations was used on carabaos again the dose of from 300 to 500 cc. was generally followed with good results. Whereas in using cattle reactor serum on carabaos, the dose used was somewhat larger. Schein (6) working on anti-rinderpest serum obtained from goats and subsequently employed on carabaos for immunization against rinderpest infers that relatively speaking, goat serum had to be used in larger quantities as compared to the dose on goats. Whether or not anti-rinderpest serum must remain true to species in order to attain its maximum efficiency or whether this phenomenon happens to be merely accidental has not been definitely established experimentally. Nevertheless, two things have been clearly established in these tests, viz., that relatively speaking the carabao when immunized by the simultaneous method would need a large dose of serum be it cattle or carabao hyperimmune or reactor serum and that such serum must be used while it is fresh.

GENERAL CONSIDERATIONS

1. Hyperimmunization as a method of preparing serum is complicated, slow, and expensive.

2. The preparation of anti-rinderpest serum from animals that have recovered from a natural infection or from a reaction as a result of simultaneous immunization is less elaborate, economical, and more rapid.

3. Our experience in the laboratory and in the immunizing stations in the field seems to point to the fact that for practical purposes there was no appreciable difference, if any, in the efficiency of hyperimmune and reactor serum especially in dealing with the carabao.

4. The protective dose of carabao or cattle anti-rinderpest serum with reference to the simultaneous immunization of native carabaos should be from 300 to 500 cc. or more and for imported breeds a much larger quantity per animal.

5. The limited trial tests on imported hyperimmune sera from Harbin and Tsinan seemed to prove that they are not different from our serum in any respect.

6. The serum alone treatment as a general field measure against rinderpest is, in the last analysis, expensive and inefficient in so far as experience in the Philipppines is concerned. In valuable animals, however, repeated large injections are very beneficial in preventing infection.

7. Immunization of carabaos against rinderpest with the simultaneous method has given good results in districts where the disease is purely endemic. Its use is dangerous in localities where the infection has been merely introduced because the immunizing station is a constant focus of infection.

REFERENCES

(1) Holmes, J. D. E.—Further investigations on questions connected with the economic production of Antisera *Memoirs of the Department of Agriculture in India,* Vol. II, No. 2, 1913, p. 34.

(2) Ruediguer, E. H.—Filtration experiments with virus of cattle plague. *Philippine Journal of Science.* Section B, (1908) 3, 165.

(3) Thomson, C. G.—Anti-rinderpest serum, its production and use. Phil. Agr. Rev. 1909, pp. 672, 673.

(4) Boynton, W. H.—Note on the organ extracts in place of virulent blood in immunization and hyperimmunization against rinderpest. *Phil.* Journ. Sci. Vol. XIII, No. 3, Sec. B, 1918, pp. 152, 153.

(5) Ward, A. R. and Wood, F. W.—Experiments on the efficiency of Anti-rinderpest serum. *Bul. No. 19,* Bur. Agr. 1912, pp. 19, 103–107.

(6) Schein, H.—Rinderpest Studies. *Annales De L'institute Pasteur* Vol. 31, No. 11, Nov. 1917.

OUR MEAT SUPPLY

By V. Buencamino, D.V.M.

The writer's purpose in selecting this subject is to put forth to live-stock owners the experience obtained in handling beef cattle, chiefly in the City of Manila and nearby provinces. This may also serve as a guiding factor for the business. A challenge of the statements made will be welcomed because no exactness and accuracy is claimed for.

Our meat supply can be divided into foreign and native. The former comes chiefly from China, Indo-China and Australia. From China the principal centers are Hongkong and Tsingtao; in Indo-China from Pnom Penh (Cambodia) and Qui-Nhon (Annam); in Australia the loading port is Wyndham. In 1919 two or three shipments were imported from India. In January, 1921, one shipment was brought over from Siam.

The native cattle.—These come from Batangas, Rizal, Tayabas, and occasionally, Ilocos; Dalupiri Island, Babuyan Island, Fuga Island; Mindoro, Marinduque, Burias, Tablas, Masbate, and Palawan. In the Visayan Islands: Capiz and Leyte. In Mindanao: Davao, Cotabato, Bukidnon, and Jolo.

Hongkong cattle.—Hongkong cattle average about 136 kilos dressed weight (12 *arrobas*). They have as a rule a fair amount of fat which is rather whitish in color. These animals are at least 5 years old, with an average of 7 years and many much older. They are docile as they are individually cared for by the Chinese who use them for work purposes. This is one of the main reasons why they can be easily shipped, cared and fed during the voyage with advantage.

The Hongkong cattle is built low to the ground, quite bulky and fleshy. Their bones are small, hence, they dress from 45 to 55 per cent according to condition. The hide of Hongkong cattle is thick and used principally for sole purposes. On account of the thickness it is priced approximately twice as much as Pnom Penh hide.

Tsingtao.—These are perhaps the biggest animals in China and approximate in size the Australian cattle, having a very large frame-work, averaging 200 kilos dressed weight or more,

with plenty of yellow fat, relatively tame but not broken to work. They are not resistant to rinderpest and are predisposed to foot diseases, because of their heavy weight. Their disadvantage lies in too large bones.

Pnom Penh.—The Pnom Penh cattle are perhaps the best for all around purposes. The average weight is about 146 kilos, age 5–7 years or more, with plenty of yellow fat. They are not quite as tame as the Hongkong cattle but once broken to work they are fast because of their rangy conformation. They are taller than the Hongkong cattle and have larger bones, hence a large proportion of the dressed weight goes into bones and lessens the actual amount of beef. These cattle are very hardy, thrive well on rice straw, and are resistant to the hard knocks of shipment. Because of these characteristics, it is the best breed to use for the manufacture of anti-rinderpest serum. As a whole the Pnom Penh cattle has a good reputation; in the local market, are very acceptable to the "tenderas" (meat sellers), and are not risky for importers to handle.

Annam.—The cattle from Annam are smaller, giving only an average dressed weight of a little over 100 kilos, a slight amount of fat and with the same docility as the Pnom Penh. On account of their small size, they are not suitable for draft purposes. The exportation from Annam is limited.

Australia.—The Australian cattle are the largest type of beef bullocks imported, the dressed weight ranging from 260–270 kilos and in some cases 300. The age is not less than 5 and by their horns there are many, ten years old. They have a large accumulation of yellow fat which in many cases goes against the beef. The amount of fat generally is two to three fold more than the Pnom Penh. The Australian cattle will dress from 50–60 per cent beef. These cattle come from large stations in range countries, have never been tied and consequently are wild, making their handling rather difficult. Because of their wildness and susceptibility to rinderpest, they are not adapted for draft purposes. The hide is twice as large as the Indo-Chinese type and only slightly thicker. It commands a price twice the Pnom Penh. The Australian beef has a ready acceptance in the market, but it is a very risky cargo to the importers, because of their wild nature, difficulty in handling, and non-resistance to disease.

Batangas.—The native cattle which approximates in weight and quality to the foreigner is the Batangas breed. The weight varies according to the age of the stock purchased. As a rule they are at least 5 years old and they average about 126 kilos dressed weight. Batangas being near to Manila, the shrinkage

from shipping is small; they are usually fattened beforehand and arrive fresh, with a fair amount of white fat. The Batangas people care for their stock individually, consequently, they are docile and broken to work. Their resistance to rinderpest is equal to the Hongkong cattle and in fact are similar in conformation to these, as a whole. The hide is as thick as the Hongkong. The Batangas cattle command the best price among all of the native stock and is the peer in the Philippines. This last statement will undoubtedly be challenged by breeders of Indian stock in the Philippines, but of course, I refer only to the condition of the cattle in Manila and not at their respective pasture. Another reason for their commanding a higher price is due to the fact that Batangas being so near to Manila the cattle are brought in within one day's notice and usually only when there is a scarcity of other stock. Naturally, a price can then be demanded.

Dalupiri.—From the Islands north of Luzon, Dalupiri is the best known. In general the average weight is around 90 kilos, age, less than five years old, usually three, hardly any fat and the meat has a dark tinge probably due to the kind of pasture and slaty ocean water. As they come direct from the range they are wild and refuse to eat during the voyage. The handling is somewhat difficult. The Dalupiri cattle is a well known native breed. I am informed that they are descendants from Spanish breed of cattle but during the last ten years or more Indian blood has been introduced. The chief objection to Dalupiri beef is its darkish color.

Fuga.—The Fuga cattle is very small everaging only at most 60 kilos dressed weight, no fat and extremely wild making the handling difficult. These cattle are the smallest that arrive in Manila. It is said that the stock is degenerated and lacks pasture for the number present in the Islands. Quite a few of these animals are used in the Serum Laboratory of the Bureau of Agriculture for control purposes.

South of Luzon.—The cattle from Masbate stands first in number and quality and, in the opinion of many dealers, is second to Batangas cattle. This is probably due to the fine pasture of the Island. Besides this fact as Masbate has quite a large cattle population and boats run weekly, a constant supply can be depended upon. Lately the type is beginning to show ostensibly the Indian blood infusion. Their weight averages 88 kilos and have a little yellow fat.

Mindoro and Marinduque cattle have the same type and weight which will average about 66 kilos, no fat to speak of, but not quite as wild as the Dalupiri. These cattle are usually

shipped in "Batels," a small type of sailing boats with a capacity of 30–40 heads.

The Mindanao type is distinctly Indian but relatively few shipments have been brought to Manila these last two years. Very likely, in the near future, by reports received, this region will be one of the main sources of beef supply.

In conclusion the following comparison of the foreign and native cattle can be made:

Origin	Weight average dressed	Age	Fat	Docility	Work
	Kilos	*Years*			
Foreign	150	6	Plenty	Tame except Australia	Adapted except Australia
Native	70	3	Little	Wild except Batangas	No, except Batangas and Indian grades

Considering that the expense in handling and slaughtering cattle is based per head (except the abattoir fees), and the care and attention for small and large cattle is the same, the dealers prefer to handle foreign cattle. It behooves, then, the owners of livestock of the Philippines to improve the native breed. The ways and means for stimulating this improvement seems to be a debatable question. The majority claim tariff protection and closure of ports; a small minority are of the opinion that the problem is similar to any other merchandise—and that is "Necessity is the mother of invention." If the native stock cannot compete then it calls for improvement of the breed through selection, castration, pasture location including transportation facilities, and fattening corrals.

THE USE OF ANTI-RINDERPEST SERUM IN THE FIELD

By H. F. Kern, D.V.M.

Anti-rinderpest serum which has been used throughout the Philippine Islands for the past several years to protect carabaos and cattle against the ravages of rinderpest, is manufactured in the laboratory from the blood of animals that have recovered from a mild attack of the disease. These immune animals, as they are known after recovery, produce a serum of varied degrees of potency according to the reactions through which the animals pass during the disease. Those animals which present severe symptom reactions and high temperatures usually produce a serum of a very high potency. Those that pass through a mild form of the disease with slight or no visible symptoms, and run a low or no temperatures produce serum of a lesser potency. It has been observed at the immunization stations where the simultaneous method of immunization is used, that carabaos produce a serum of higher potency than cattle, probably due to the severe reactions through which they pass.

The potency of the serum also depends upon the length of time the animal is bled for serum after fully recovering. The serum is found to be of highest potency about the ninth day, and gradually becomes less as the number of days increase until the animal is bled. This does not signify, however, that serum from an animal that has been attacked with rinderpest, will in time become entirely impotent. An animal once attacked with rinderpest, unless it is very young, will retain sufficient anti-bodies for its own protection against a subsequent attack.

Too much care cannot be exercised in the proper use of serum in the field, especially in acquainting the people on whose animal it is used, with the results they may expect. The veterinarian himself, may not sometimes know that the results will be in certain localities, and should keep a close observation on the first animals injected.

It must also be kept in mind that whenever anti-rinderpest serum is used in the field, it is a preventive against rinderpest and not a curative as is sometimes supposed. At the immunization stations where animals are given virus in connection with the serum simultaneously, and the temperatures

of the animals recorded twice daily, serum may be used to some extent as a curative. Even then, the serum must be given at the first rise of temperature and continued for two or three successive days if any curative effect is to be expected. Animals that are found sick during the performance of ordinary field work, have invariably had a rise of temperature for two or three days, and consequently the use of serum on these animals as a curative would be of no value.

Serum of low potency will not give satisfactory results at any time, and should never be used in the field unless it has been previously tested and it is positively known what amount to inject. Most of the serum manufactured in the Philippines can be depended upon to give good results provided it has been properly preserved and kept in a cool place. Serum that is a year or more old cannot be relied upon to give satisfaction and should not be used except when absolutely necessary.

Serum stored and kept in the field should not be allowed to come in contact with the sun and light, until just before it is used on the animals. The color of the serum has nothing to do with its potency, and serum of a dark color may be just as potent as that of a lighter color. If the serum has spoiled, gas will usually be found in the bottles upon opening, in which case the serum should not be used. When serum is properly made and stored, it will not spoil for several years, but becomes very much lowered in potency.

The majority of people who own livestock give very little or no personal attention to their animals until they find them sick, and then rush to the veterinarian for whatever assistance he can offer. Sometimes the veterinarian in sympathy with the owners of the animals, undertakes to render aid by the use of the serum. Although the owner may beg to have serum used on his infected animals, its use under these conditions should never be undertaken, and is to be condemned in every instance. In practice many of these infected animals so treated are certain to die regardless of the treatment, and the significant fact is, that many times the veterinarian will be criticised or the serum condemned.

The owner may, however, have animals in the same herd which show no visible symptoms of rinderpest, and the question arises as what is to be done with them. It can usually be determined by the course of the disease whether it is advisable to use serum. In large herds which are already infected with rinderpest, and where the animals are highly susceptible and mingle freely with one another, the use of serum is not advisable. But, if the

disease is mild, and the herd is separated into several smaller herds, the majority of which are not infected, the use of serum frequently gives exceptionally good results. Even though the animals continue to become sick some effect will be obtained from the serum and there will be in all probability a good percentage of recoveries.

There are sometimes inquiries relative to the use of serum on animals which are in the vicinity of infected animals. If it appears that there is danger of these non-infected animals becoming infected within a few days, it is advisable to suggest to the owner the use of serum. If, however, the animals are some distance from the infected area, and there is no danger of their becoming infected for two or three weeks, it is better to wait for a week or so before using serum. Much upon the financial position of the owners, some people may be able to have their animals injected with serum two or three times, while others cannot afford to pay the cost of the serum for one injection.

Anti-rinderpest serum produces a passive immunity and not an active immunity as is sometimes thought. Judging from the statements that are sometimes heard from the people, they are many times led to believe that serum *alone* confers an immunity which will last for one or two years. The duration of immunity from serum vàries in different animals, but seldom if ever over two or three weeks, among the animals in the Philippine Islands. By using the maxim dose, there are instances on record where the immunity conferred by serum has not been over ten days. However, where animals are injected with serum alone, and a period of two or three weeks pass before the animals become infected, a larger number of recoveries may be expected than if the serum had not been used.

The amount of serum to be given each animal in order to obtain immunity varies according to the locality, and animals in one province may require double the dose of those in another. In localities where rinderpest has existed for several years, the animals acquire some immunity, while in others where there is no disease the animals are most susceptible. During the year 1919, when immunization stations were conducted at Angeles, Pampanga, and San Miguel, Bulacan, it was found that the animals at the San Miguel station required almost double the amount of serum to protect them, than those at the Angeles station. Even though, animals may be only a few kilometers apart there is found to be a great difference in their susceptibility. As before stated, in territory where rinderpest has existed

for several years the animals acquire a certain amount of resistance against the disease. This resistance is also lost in territory that has remained free from rinderpest for two or three generations, and the animals again become less resistant to the disease.

The size and age of the animals has some bearing on the amount of serum necessary to confer immunity. Young animals which are full grown require considerably more serum than old animals of the same age. It is always better to give sufficient serum at one injection, rather than run the chance of having to undertake a second injection after the animals have become sick. In practically all instances in the Philippine Islands where the animals are highly susceptible to rinderpest, 300 to 400 cc. of serum will protect cattle and 400 to 500 cc. will protect carabaos for a period of two or three weeks.

The manner of administering the serum is not difficult, but there are always some precautions which should be taken if the best results are to be expected. The serum should be injected under the skin on the back of the animal where the least amount of connective tissue is found. Care must be exercised that the needle is not passed through the skin between the ribs into the body cavities. The skin of the animals at the point where the serum is to be injected should be washed, and disinfected with either creoline or lysol solution before the injections are made. If there is any danger of the carabaos getting in wallows immediately following the injections, it is advisable to cover the needle holes with pine tar or some other thick medicinal agent. When it is possible, and especially where large amounts of serum are used the dose should be divided into two parts, and one part injected on each side of the animal. After the injections are made, the serum must be massaged under the skin to stimulate absorption, and prevent any abscess formation. Special care will have to be given to small calves where they are injected in a recumbent position, to prevent any infection entering from the outside. It frequently happens that small calves must be thrown on the ground while the injections are made, and there is always a possibility of infection from this source. Animals that are injected with anti-rinderpest serum *alone* do not have any reaction following the inoculations, and consequently it is not necessary to keep the animals tied or confined afterwards.

Anti-rinderpest serum unless used simultaneously with virus will never be a great adjunct in helping to free the Philippine Islands from rinderpest. The duration of the immunity conferred by serum *alone* is too short to give other than temporary

relief. If it was possible to inject all the animals on an infected island which are subject to rinderpest, in the course of a week; there would be a possibility of freeing that particular island from rinderpest. But so long as sporadic case of rinderpest remained either in the domestic or wild animals, there would be in all probability a reinfection, as soon as the immunity from the serum had become negative.

ASCARID INFESTATIONS OF DOMESTIC ANIMALS IN THE PHILIPPINE ISLANDS

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INTRODUCTION

In view of the newly recognized pathogenic rôle of parasitic worms belonging to the genus *Ascaris* and related genera in the family *Ascaridae*, the following notes concerning the occurrence of these worms in domestic animals in the Philippine Islands may serve a useful purpose by focusing the attention of live-stock owners, veterinarians, animal husbandmen and others that are interested in animal diseases, on these harmful parasites. Inasmuch as no records have been published heretofore concerning the occurrence of ascarids in domestic animals in the Philippines, excepting a record regarding the occurrence of one species in dogs, the following notes will also serve as records of the presence of these potentially dangerous parasites in live-stock of these Islands.

ASCARIS EQUORUM (GOEZE, 1782)

This parasite occurs all over the world in the small intestine of equine animals. It has also been recorded from cattle by Schneider (1866) but it is highly probable that Schneider's determination was faulty, the species in question being *Ascaris vitolorum.*

Specimens of *Ascaris equorum* have been collected from native horses in Los Baños. No heavy infestations have been observed. The number of specimens collected from individual hosts was generally small, seldom exceeding five or six. It must be stated, however, that horses examined by the writer for the presence of parasites were old, a fact which may have an important bearing on the scarcity of the worms. Other internal parasites, such as *Habronema, Strongylus, Cylicostomum, Oxyuris,* and other nematodes were generally found in great abundance.

The presence of ascarids in young horses may occasion considerable trouble such as colic and chronic intestinal catarrh, with a more or less pronounced diarrhoea. The animals may

also exhibit nervous symptoms, such as vertigo, epilepsy, and tetanic contractions of the muscles.

ASCARIS LUMBRICOIDES (LINNÉ, 1758)

This species occurs in the small intestine of human beings and pigs. The name *Ascaris suum* (Goeze 1782) is frequently applied to the large roundworm parasite of the latter host, but this differentiation of species is based entirely on host relationship and not on zoölogical characters, so far as our present knowledge goes. It is convenient to refer to pig ascarids as *Ascaris suum* but that specific name has no zoölogical basis.

Ascaris lumbricoides is comparatively rare in adult swine in the Philippines. This parasite is quite uncommon at the Azcarraga abattoir in Manila. The writer spent several hours carefully observing the stripping of intestines and but few ascarids were obtained in the course of an afternoon during which several hundred hogs were slaughtered. From one to four specimens, usually one or two, were obtained from the positive cases, the latter being very infrequent. These observations on the scarcity of ascarids in Philippine swine have been confirmed by the writer's assistant who visited the Azcarraga abattoir daily for one month. That the scarcity of *Ascaris* in swine is apparently normal, so far as observations at the Azcarraga abattoir are concerned, was confirmed by meat inspectors and by persons employed in stripping and washing hog intestines. It should be stated in this connection that very few of these parasites would escape attention because the intestines are not only carefully stripped but they are also turned inside out and the mucosa is thoroughly rinsed in running water.

The following notes taken from the post-mortem records of the laboratory of parasitology of the College of Veterinary Science of the University of the Philippines for the year 1921 will serve to illustrate specifically the incidence of *Ascaris lumbricoides* in pigs.

Out of twenty-nine pigs that were examined twenty-two were entirely free from *Ascaris*. In one case thirty-four specimens were found, in another case ten specimens were found, in a third case four specimens were found, and in the remaining four positive cases one specimen was found in each hog. With the exception of three or four animals, the pigs on which these records are based, were slaughtered for human consumption. Examination of the intestines of seven wild pigs trapped on the College Campus at Los Baños failed to disclose any ascarids.

In contrast to the infrequent occurrence of *Ascaris lumbricoides* in swine is the common occurrence of this species in man

in the Philippine Islands. Thus, Garrison (1908) records that 25 per cent of about 4,000 persons examined were positive for *Ascaris*. The same writer in collaboration with Llamas (1909) found about 80 per cent *Ascaris* infestation in about one thousand stool examinations. Rissler and Gomez (1910) in several hundred stool examinations found 50 per cent positive for *Ascaris*. Chamberlain, Bloombergh, and Kilbourne (1910) found that over 70 per cent of the several hundred Igorots that they examined harbored *Ascaris*. Willets (1911) found over 60 per cent positive for *Ascaris* based on about four thousand examinations. The same writer (1913) records over 90 per cent positive for *Ascaris* based on four hundred stool examinations. Reports concerning infestation of Filipinos with intestinal parasites, published since 1913, show that approximately 50 per cent of the native population harbor *Ascaris lumbricoides*.

It is quite evident from the above data that *Ascaris lumbricoides* is far more prevalent in man than in pigs, so far as the records for the Philippine Islands are concerned. This fact is astounding in view of the ready access that swine have to human feces owing to the scarcity of privies in the provinces of the Islands.

The possibility that native pigs may have a great resistance to *Ascaris* infestation should not be overlooked. Pigs slaughtered for human consumption in the Philippines are of mixed breed, and it is by no means improbable that this may account for the comparative scarcity of *Ascaris* in Philippine swine.

In considering the pathogenecity of *Ascaris lumbricoides* it is convenient to consider the effects of the migrating larvae and the effects of the adult intestinal parasites, separately. So far as concerns the migrations of the larvae with the resultant invasions of the lungs, it was first shown by Stewart (1916) that a serious, and sometimes, a fatal pneumonia may result. Ransom and Foster in several publications (Ransom and Foster 1917, 1919, 1920, Ransom 1919) have confirmed this fact and have shown, moreover, that a lung disease of pigs, commonly known as "thumps" resulting in numerous deaths, may often be caused by *Ascaris* larvae invading the lungs.

In addition to stunted growth, pigs harboring adult ascarids may exhibit the usual symptom complex of intestinal parasitism, such as listlessness, unthriftiness, lack of appetite, emaciation, anemia, etc.

ASCARIS VITOLORUM (GOEZE, 1782)

This parasite is recorded by Ransom (1911) from cattle and from zebu. It has been found by the writer in Indian cattle

and in native carabao in Los Baños. Reports of the occurrence of this parasite in Mindanao are authentic and specimens collected from calves in Mindanao have been received by the writer through the courtesy of Dr. Youngberg of the Bureau of Agriculture.

Three calves, one an Indian buffalo and two native carabaos, from the herd of the Department of Animal Husbandry of the College of Agriculture, University of the Philippines, Los Baños, recently died from heavy infestations with this parasite. The animals were emaciated, listless, refused to eat, and several hours before death they were prostrated and showed labored respiration, violent tetanic contractions of the muscles, and other nervous symptoms. Post-mortem examination revealed few ascarids in the fourth stomach and almost complete obstruction of the duodenum due to the abundance of the worms. Local inflammation of the intestinal mucosa was quite marked. Dead parasites, due probably to effects of anthelminthics that were administered were found in various stages of digestion in the small and large intestines, the animals having been severely constipated before they died.

According to Hutyra and Marek (1910) Gasteiger distinguishes two clinical forms of ascariasis in calves. In lightly infested cases the breath of the animal has a peculiar odor, resembling chloroform, ether or alcohol, the feces is light in color, but coughing and emaciation are rare. In heavy infestations there are loss of appetite, constipation or diarrhea, flatulence, profuse urination, labored breathing as well as nervous symptoms.

Ascaris vitolorum is a very dangerous parasite of cattle and carabao and is probably responsible for numerous losses among calves throughout the Archipelago.

BELASCARIS MARGINATA (RUDOLPHI, 1802)

This species has been found in dogs autopsied by the writer and his students at the clinic of the College of Veterinary Science, but infestations were uncommon and generally light. The dogs in question were nearly all adults. Specimens of this species have all also been obtained from a veterinary hospital in Manila through the courtesy of Dr. Gomez.

Wharton (1917) in a paper on intestinal parasites of dogs in the Philippine Islands records *Toxascaris limbata* (Rail and Henry, 1911) in about 7 per cent of the dogs that were autopsied in the College of Medicine and Surgery, Manila. He does not report the occurrence of *Belascaris*.

BELASCARIS CATI (SCHRANK, 1788)

This species has been collected from native cats. As in the case of *Belascaris marginata*, this parasite was not very common and infestations were rather light.

ASCARIDIA PERSPICILLUM (RUDOLPHI, 1803)

This species is quite common in chickens in Los Baños. In the spring of 1920 nearly every chicken that was autopsied contained many of these parasites. Tobacco infusion as recommended by Herms and Beach (1916) was administered to chickens belonging to the Animal Husbandry Department, and according to statements by members of that department mortality among the birds decreased and egg laying was noticeably increased following that treatment.

HETERAKIS PAPILOSA (BLOCH, 1782)

Heterakis papilosa is a small nematode, parasitic in the caeca of chickens, turkeys and other birds. This species is quite common in native chicken.

The above-mentioned species from chickens are not ascarids in a strict zoölogical sense, since they belong to the family *Heterakidae*, whereas the other species of ascarids mentioned in this paper belong to the family *Ascaridae*. The forms from chickens are included in this paper because for practical purposes they may be considered together with ascarids of other domestic animals.

TREATMENT FOR ASCARIS INFESTATION

In a recent paper on parasitic diseases of livestock by Ransom and Hall (1920), the following treatments for *Ascaris* infestation, based on Hall's experimental work with anthelminthics, are recommended:

For ascarids in dogs, American worm seed oil (oil of chenopodium) in doses of 0.1 mil per kilo with an ounce of castor oil. For ascarids in swine the same drug in doses of 4 mils per hundred pounds of live weight with 2 to 4 ounces of castor oil. For *Ascaris* infestation in the horse, carbon bisulphide in 6-dram doses, two 4-dram doses at two-hour interval, or three 3-dram doses at four-hour intervals.

Whether any of the drugs that are commonly employed as roundworm remedies are efficacious against ascarids in calves still remains to be determined.

For roundworms of poultry, the following treatment, devised by Herms and Beach (1916), was tested at the College of Agriculture at Los Baños with successful results:

Tobacco leaves and stems were chopped up and soaked in enough water to keep them covered. Both the chopped tobacco and water were mixed with half the normal ration and fed to the birds. One pound of tobacco stems and leaves (453 grams) was sufficient for treating 100 chickens. Two hours later one-fourth of the usual ration was mixed with Epsom salt at the rate of 312 grams for 100 fowls, and fed to the chickens. The treatment was repeated one week later.

This treatment is inexpensive, easily administered, and should be applied whenever roundworm infestation in domestic birds becomes troublesome.

REFERENCES TO LITERATURE CITED

(1) CHAMBERLAIN, W. P. BLOOMERGH, H. D. and KILBOURNE, E. D. *Phil. Journ. Sci.*, Sec. B. (1910), 5, 505
(2) GARRISON, P. E. *Ibid.* (1908), 3, 191
(3) GARRISON, P. E. and LLAMAS, R. T. *Ibid.* (1909), 4, 185
(4) HERMS, W. B. and BEACH, J. R. *Cal. Agr. Exp. Sta. Circ.* 150 (1916)
(5) WHARTON, L. D. *Journ. of Parasit.* (1817), 4, 80
(6) HUTYRA, FRANZ and MAREK, JOSEPH. *Spezielle Pathologie and Therapie der Haustiere* (1910) Jena
(7) RANSOM, B. H. Bull. *Bur. An. Ind.* (1911), No. 127
(8) RANSOM, B. H. J. *Amer. Med. Ass.* (1919), 73, 1210
(9) RANSOM, B. H. and FOSTER, W. D. *Journ. Agric. Res.* (1917), 11, 395
(10) RANSOM, B. H. and FOSTER, W. D. *Journ. of Parasit.* (1919), 5, 93
(11) RANSOM, B. H. and FOSTER, W. D. *Bull. U. S. Dept. Agric.* (1920), No. 817
(12) RANSOM, B. H. and HALL, M. C. *Journ. Am. Vet. Med. Ass.* (1920), 57,394
(13) RISSLER, R. S. and GOMEZ, L. *Phil. Journ. Sci.* Sec. B., (1910), 5,257
(14) SCHNEIDER, A. *Monographie der Nematoden* (1866), Berlin
(15) STEWART, F. H. *Brit. Med. Journ.* (1916), 2, 5
(16) WILLETS, D. S. *Phil. Journ. Sci.*, Sec. B. (1911), 6, 77
(17) WILLETS, D. S. *Ibid.* (1913), 8, 49.

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UNIDENTIFIED DIETARY ESSENTIALS IN THE RATION OF DOMESTIC ANIMALS [1]

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The feeding of livestock received no scientific attention until 1859, when chemistry threw some light on the composition of feeds. From the analysis of the chemical composition of the body of animals the theory was advanced that because the body is made up of proteins, carbohydrates, fats, and mineral salts, and because the essential constituents of the normal diet are of the same composition, the principal activity of the investigator of nutrition was centered in the chemical analysis of feeds in order to determine what were supposed to be the only essential food complexes. Meat, milk, eggs, and a few seeds such as the pea and bean are very rich in protein, the cereal grains contain less of this food substance, whereas the tubers and vegetables, especially in the fresh condition, contain but very little. Equally great variations are observable in the water content of foods, and in their yields of fats and carbohydrates. Atwater and his associates examined and tabulated in classified form the chemical composition of an extensive list of human foods. This was the beginning of a great epoch in the development of the science of nutrition. Later on, the Agricultural Experiment Station accumulated similar data concerning animal foods. Up to about 1900 the idea that there was any variation in the quality of the proteins from different sources had not become generally appreciated.

It has been observed that restricted diets of monotonous character have produced, for centuries, diseases in man in several parts of the world. Scurvy was a general disease which caused much suffering among sailors in the days of the long voyages. It was then made clear that it was a sequel of the consumption of a faulty diet, composed of biscuit and salted meat. Prompt recovery followed by giving a liberal amount of fresh vegetables and fruits. Pellagra was one of the scourges among the poorest peasants in some parts of Europe for cen-

[1] Presented in the Tenth Annual Meeting of the Philippine Veterinary Medical Association, February 5, 1922.

turies. Its cause has been attributed by many to a poor quality of simple and monotonous diet. This disease was not observed in America until 1900. It is now being increased steadily in the Southern States. Beri-beri is a disease common to the people of the Orient, who limit their food supply to polished rice and fish. It was not until 1897 when Eijkman made the first suggestion with reference to the nature of the dietary fault which was responsible for the development of this disease. Men as well as animals have been sufficiently industrious in most parts of the world to secure for themselves a varied diet derived from cereal grains and legumes, fruits, roots and tubers, meat, and certain leaves which are found edible.

In the year 1907 McCollum began the study of the nutrition problem at the Wisconsin Experiment Station. The literature on nutrition at that time was limited. Henricks and Hansen believing that gliadin, one of the proteins of wheat, was free from the amino acid lysine, made up a diet of purified gliadin, carbohydrate, fat, and mineral salts, and attempted to nourish on this food mixture animals whose growth was complete. It was reported that rats were kept in a state of nitrogen—equilibrium and even retention of nitrogen, protein, during an experimental period covering nearly a month. In most of their trials the animals were fed steadily from the time they were confined with food of this character. Similar experiments were made by Willcock and Hopkin in which the protein of the diet was zein obtained from maize, and the mice lived but a few days. At the Wisconsin Experiment Station there was in progress at that time an experiment which McCollum was working on, in which he believed that by employing such diet of protein, carbohydrate, and fat and mineral salt and by a systematic addition of one or more purified substances to be found in natural food or in animal tissues, it would be possible to arrive at the solution of the problem of what chemical complex is necessary in the diet of higher animals. The above experiment is based upon earlier work by Prof. Babcock and was suggested by him and carried at first by Prof. Hart and Humphrey and later with the coöperation of Steenbock and McCollum. In this experiment the object was to determine whether the rations so made up as to be alike in so far as could be determined by chemical analysis, but each derived from a single plant, would prove to be of the same value for growth and the maintenance of vigor in cattle.

The ration employed for one group of animals was derived from the wheat plant and consisted of wheat gluten and wheat

straw; the second group was fed on corn plant products, corn gluten and a by-product of the corn industry and the leaves and stalks of the corn plant (corn stover); and the third group derived the ration solely from the oat plant being fed entirely on oats and oat straw. There was a fourth group which was supposed to serve as control, and was fed on a ration having the same chemical composition but derived from about equal parts of wheat, corn, and oat products. The animals employed were young heifer calves weighing about 105 pounds and were as nearly equal in size and vigor as could be secured. They were restricted absolutely to the experimental diet. They were given all the salt they cared to eat and were allowed to exercise in an open lot free from vegetation. Their behavior during growth and in performing the function of reproduction were extremely interesting. All groups ate practically the same amount of feed, and digestion tests showed that there was no difference in the digestibility of the three rations.

It was after the animals had been confined to their experimental rations for a year or more that distinct differentiation in their appearance was easily observable. The corn fed group was sleek and fine and was evidently in an excellent state of nutrition. In marked contrast stood the wheat fed group. These animals were rough coated and gaunt in appearance and small of girth as compared with those fed with the corn plant ration. The weight of two groups did not differ to a significant degree. The groups fed with the oat plant ration and the mixture of the three plants, leaf and seed, stood intermediate between the two lots just described. The assumption that the animals receiving the mixture of products would do better than any of the others, and thus serve as the standard group for controls was not realized. The corn fed animals were at all times in a better state of nutrition than were those receiving the greater variety of food materials.

The reproduction records of these animals are of special interest. The corn-fed heifers invariably carried their young the full term, and the young showed remarkable vigor. All were normal in size and able to stand and suck within an hour after birth as is the case with vigorous calves. All lived and developed in a normal manner. The young of the wheat fed mothers were the reverse in all respects. All were born 3 to 4 weeks too soon, and all were small and weighed on an average of forty-six pounds, whereas the young of the corn-fed animals weighed 73 to 75 pounds each. This latter weight is normal for newly born calves. The young were either dead when born

or died within a few hours. The young of the mothers which had been grown on the oat plants were almost as large as those from the corn-fed mothers, the average weight being 71 pounds.

All of them delivered their calves about two weeks too soon. One of the four was born dead. Two were very weak and died within a day or two after birth. The fourth was weak, but with care it was kept alive. The young of the cows fed with the mixture of the three plants were weak in most cases, and one was born dead and one lived but six days. The mothers were kept on experimental rations, and the following year they repeated in all essential details the reproduction records observed in the first gestation period.

Records were kept of the milk production during the first thirty days of the first lactation period. The average production per day by each individual in the corn-fed lot was 24.03 pounds; for the wheat-fed animals 8.04 pounds and for the oat-fed animals 19.38 pounds. Those fed on the mixture of the three plants produced 19.82 pounds of milk per cow per day during the first thirty days. In the second lactation period the figures for milk production were 28, 16.1, 30.1, 21.3 pounds, respectively, per day during the first 30 days.

Through autopsy and analysis of tissues of the young, and analysis of the feces and urines of the animals in the several groups, an elaborate attempt was made to solve the problem of the cause for the marked differentiation of the animals fed on these restricted diets. The urines of the wheat-fed animals were invariably distinctly acid in reaction, whereas those from the other lots were alkaline or neutral to litmus indicator. It was not possible, by any means known to physiological chemistry, to obtain a clue to the cause of the pronounced differences in the physiological well-being of the different lots of cows. The experiment confirmed McCollum's conviction that the only way in which the problems of nutrition could ever be solved, would be to solve the problem of the successful feeding of the most simplified diets possible. If this were accomplished it would be possible to proceed from the simple to the complex diets employed in practical nutrition, ascertaining the nature of the dietary faults in each of the natural foods, singly, the seed alone and the leaf alone before attempting to interpret the causes of malnutrition in animals fed on the more complex mixture.

Such an undertaking as that just described, that is, the solution of the problem of why animals do not thrive on a diet of purified protein, starch, sugars, fat, and inorganic salts which

contained all the elements known to be left (as ash) on the incineration of the animal body, necessitated the employment of small laboratory animals.

A sufficient number of comparable experiments have now been conducted with several species of animals to make it appear that the chemical requirements of one species are the same as those of another among all the higher animals. The requirements with respect to the physical properties of the food vary greatly. The ruminants must have bulky food with the right consistency, whereas the omnivora (man, pig, rat, etc.) cannot, because of the nature of their disgestive tracts, consume enough of such food as leaves and coarse vegetables to meet their energy requirements.

The early efforts to nourish young rats on diets composed of purified proteins, carbohydrates, fats, and mineral salts, confirmed results of earlier investigators. The animals lived no longer on such food mixture than if allowed to fast. The rations employed were of such character that a most thorough analysis can reveal no reason why they could adequately nourish the animals. It seemed obvious that there was something lacking in such a mixture which is indispensable for the nutrition of the animals. It was not until 1912 that some light was obtained on this problem. The diet which was mostly in use at that time consisted of purified casein to the extent of about 18 per cent, lactose 20 per cent (supposed to be pure), a mixture which was made up in imitation of the mineral contents of milk and the remainder of starch to make 100 per cent. This food mixture was supposed to be composed of material sufficiently pure to comply with the requirements of such work, that is, they were supposed to contain too little of any impurity which would in any way influence the results. With this diet the interesting observation was made that growth could be secured where fat in the food mixture was a butter fat, whereas no growth could be secured when the butter fat was replaced by lard, olive oil, or other vegetable oils. Egg yoke fat would similarly induce growth in the same manner as butter fat. It was therefore definitely established that contrary to the past belief the fats are not all of the same dietary value.

The portion of the food mixture other than fat appeared to contain only substances of known composition, that is, protein, carbohydrate, and inorganic salts, and for a time it appeared that the unknown substance in the butter fat was the only element of mystery in the diet, the tentative conclusion of which, was that the essential factor in an adequate diet includes one

substance or a group of substances which had not been appreciated in the past, and that these, if there are more than one, are associated with fats but not with all constituents. This is in harmony with the findings of Stepp in 1909. Stepp considered the unknown substance, or substances, one which he was dealing with in his feeding work, as belonging to the not well-defined group of substances generally called lipoids. This group includes fats, and related substances more complex in character, some of which contain the elements phosphorus and nitrogen. Hofmeister defines the unknown as "accessory foodstuff," Hopkin as "accessory factors," and Funk has called them "vitamines." Objection was necessarily made at the time, on the ground that this implied something not essential, and to the term vitamines on the ground that there is no evidence that the substance or substances in question are amines nor that they are more valuable to life than the other substances. In acknowledgment to this insufficiency of information, McCollum suggests the provisional use of two terms, the Fat-soluble A and Water-soluble B as representing the factors necessary for adequate growth. Water-soluble B cures beri-beri in humans, or polyneuritis in animals, and is regarded as identical with Funk's vitamines.

All natural foodstuffs such as the plant leaves, the leafy vegetables, roots, fruits, tubers, meats, eggs, and milk contain the amount of all the substances which are indispensable components in the diet. There is, however, great variation in the quality of the different foods in respect to the several factors. Some contain very much protein; others, little, and a similar relation in respect to other constituents is found.

The best sources of Fat-soluble A (the essential for growth) are whole milk, butter fat and egg yolk fat, and the leaves of plants. The seeds of plants contain less and those products derived from the endosperm of the seeds are very poor in this substance. Such foodstuffs as bolted flour, germinated corn meal, cane, and beets are practically free from the Fat-soluble A. The specific results of a lack of sufficient amount of this substance in a diet, is the development of a condition of the eyes which appears to be rightly classed as a type of Xerophthalmia. The eyes become swollen, so badly that they are opened with difficulty or not at all. The cornea becomes inflamed and unless the missing dietary essential is furnished blindness speedily results. Osborne and Mendle have also noted this condition in experimental animals and its relief by feeding butter fats. The introduction in the diet of 5 or more per cent

of butter fat will cause prompt recovery in cases where the animals are within a few days of death. Complete recovery takes place within two weeks if the sight has not been destroyed. The normal condition of the eyelids can be restored even after the sight has gone and the cornea has faded. When judging the effect of a diet on an animal, it is necessary to take into account the fact that the diet is a complex thing and that if it is properly instituted in respect to all factors but one, an animal may tolerate it without apparent injury whether the fault lies in one or another of the essential components. The value of one component may fall well below that which will lead to serious malnutrition when a second dietary factor is likewise poor.

The idea should not be entertained that butter fat is the only food which supplies the Fat-soluble A. If the diet contains a liberal amount of milk, eggs, glandular organs or the leaves of plants, it will if otherwise satisfactorily executed prevent the onset of eye disease. The seed and seed products such as wheat flour (bolted), the germinated corn meal, polished rice, starch, sugar, syrup, tubers, roots such as the raddish, beets, carrots, turnips, etc., and also the muscle tissue of animals such as ham, steak, chop, etc., do not contain enough of the Fat-soluble A to be classed as important sources of this dietary essential. The tubers and roots appear to be somewhat richer in it than are the seeds.

McCollum and his co-workers have repeatedly observed in experimental animals the type of Xerophthalmia of dietary origin which has been observed above. They have many times rescued animals from the threshold of death by the addition of butter fat to diet of animals which are suffering from the disease brought about by lack of a sufficient amount of Fat-soluble A in their food. It seems certain that these cases of Xerophthalmia should be looked upon as a deficiency disease not hitherto recognized in its relation to diet. It is not a fat starvation but if it be the same condition which McCollum and Simmonds have definitely shown to be readily relieved in its earlier stages by the administration of such foods as contained a liberal amount of Fat-soluble A, it would not be relieved by feeding with vegetable fats in any amount. Milk, eggs, leafy vegetables, and the glandular organs are the foods which serve to protect against a shortage of these indispensable dietary components. This type of Xerophthalmia is analogous to polyneuritis in that it is due to a lack of a specific substance in a diet. Beri-beri and Xerophthalmia are, according to McCollum and Simmonds, the

only diseases attributable to diet which are to be explained in this way.

Polyneuritis was first produced in animals by Eijkman in 1897. He discovered that when pigeons and chickens were restricted to diets of polished rice they steadily lost weight and in time came to manifest all the essential symptoms characteristic of beri-beri in man. In pigeons the disease usually appears in 2 to 3 weeks. He found that feeding rice polishings would produce a relief of the symptoms. This result suggested that there was lacking in polished rice something which was necessary for the maintenance of health in birds and that something was present in the rice polishings. This was the first experimental evidence that there exists something which is necessary in the diet other than protein, carbohydrate, fats, and inorganic salts.

The observations of Eijkman attracted but little attention until Funk took up the study of beri-beri in 1910. Fraser and Stanton had as early as 1907 employed alcoholic extracts of rice polishings for the cure of experimental polyneuritis. Funk made numerous studies directed toward the isolation and study of the substances which exerted curative effect and developed in his writings the well-known vitamine hypothesis. This hypothesis postulated the existence of a similar protective substance for each of the diseases Scurvy, Pellagra, and Rickets, in addition to that which in the normal diet protects against beri-beri. The peculiar value of butter fat was unknown to him and he classed it among the food substances which contained no vitamine because its administration to polyneuritic pigeons produced no beneficial effect. Funk deserves more credit than that which he secured. The amount of the substance which can be extracted from rice polishings, necessary to cause the relief of polyneuritis in pigeon, is exceedingly small, a few milligrams of material which is contaminated with the substance sufficing to bring relief to a bird which is in a helpless condition, and within a few hours of death, and to make it appear like a normal pigeon.

There can be no doubt that there are two deficiency diseases in the sense in which Funk and his co-workers employed this term, one of these is beri-beri and the other the type of Xerophthalmia which McCollum and Simmonds have worked on occurring occasionally in man as a result of faulty diet, and have demonstrated to be the same condition which results in animals as the result of specific starvation for the unidentified dietary essential, Fat-soluble A. Other supposedly deficiency diseases like Scurvy

and Pellagra may be very well discussed in this paper but owing to their non-existence in the domesticated animals I do not deem it proper to do so.

However, in a biological study of copra meal with guinea pigs as published by the *Philippine Agriculturist*, September, 1921, Vol. X, No. 2, very interesting results were obtained with reference to feeding the guinea pig with one of the principal local products, copra meal. The paper summarizes as follows:

1. Copra meal alone or even when supplemented with purified food was highly constipating, at least for guinea pig. This constipation in the caecum caused congestion and hemorrhages around the caecum and rectum; scurvy then developed.

2. Green guinea grass and copra meal were excellent supplementary foods and they could maintain weight, promote growth and reproduction in guinea pig.

3. Without a non-antiscorbutic vitamine, copra meal could not be supplemented with purified food even with Fat-soluble A and Water-soluble B and maintain the life of guinea pig. This antiscorbutic vitamine was found in guinea grass and orange juice.

4. Although guinea grass given dried at 60 to 80° C given ad libitum seems to satisfactorily supplement copra meal 20 per cent or even 33⅓ per cent of this in a ration of copra did not contain sufficient antiscorbutic vitamine to keep guinea pig free from scurvy.

This work seems to favor the fact that scurvy is produced definitely from a faulty diet but McCollum and his co-workers do not believe that scurvy is a deficiency disease because from their experiments there was strong evidence to think that scurvy is produced from bacteriological origin. The weight of arguments until the present date is still unsettled.

From the foregoing, it should be observed that the compounding of ration for domestic animals does not only need a knowledge of the actual composition of feeds obtained from direct chemical analysis but also their biological values. It is evident that diets may furnish an abundance of protein and energy and may be easy of digestion, and may furnish a wide variety and include several seeds or products derived from them, together with tubers, roots, and meats, and may be highly palatable and yet fail utterly to support satisfactory nutrition. In other words, we must have a language of nutrition, and consider feeds on the basis of their protein, carbohydrate, fat, water, and mineral contents. We should be familiar with the quota of energy available from the different types of feeds. We must, however,

take into consideration certain facts which have not hitherto been considered and concerning which chemical analysis gives no information.

One of the outstanding results of modern research in nutrition is the great difference in the biological values of the proteins from different sources. In a general way this is appreciated by all well informed teachers of the present day, but many are still in need of clearer distinctions regarding what data in literature are capable of direct application to practical nutrition and what are of such a nature that can not be so applied. As an example may be cited the laborious studies through which the amino-acids became known, and the data yielded by such a method of analysis of the proteins as those of Fisher and of Van Slyke.

Chemical analysis shows the proteins of the pea and bean to contain all the known amino-acids, and none of them are present in excessive or in minimal quantities, whereas the wheat and maize proteins yielded excessive amounts of one of them in particular.

It should be understood that the values for the proteins of the seeds apply only to the proteins of the single seed when fed as a sole source of protein. When fed in mixture of two or more proteins, having individually low values for the support of growth, they may mutually make good each other's amino-acid deficiencies from a mixture which is better than either constituent when fed singly. Almost all the Experiment Stations in the United States are engaged in this work. The combination of many different feeds for all kinds of livestock is the feature of their activity. Lately the Wisconsin Experiment Station has obtained wonderful results in their trials with pigs to test the feeding value of yellow and white corn. This was a question which perplexed Prof. Steenbock during the past years when the knowledge of nutrition was yet in hazy mist. With the results obtained by Prof. Morrison, Fargo, and Bohstedth, the superiority of yellow corn over white corn under certain conditions was definitely established.

A thorough knowledge of these unidentified dietary essentials is of paramount importance to live-stock men both from the scientific and practical standpoints. The present scheme to fatten young animals for market calls for an understanding of both the chemical composition of feeds as well as their biological properties. Besides providing the animals with sufficient nutrients to meet the standard requirements for their given

weight, as well as for production, it should also not be overlooked that in the ration, feeds rich in Fat-soluble A (the essential for growth) must not be omitted. This is also true when the ration of nursing mothers is prepared. Neither Fat-soluble A nor Water-soluble B is synthesized in the animal body. Experimental evidence substantiates this fact. And for the proper nourishment of the young the Fat-soluble A must be present in the ration but never expect it to be manufactured in the mammary tissues of the female. McCollum, Simmonds, and Pittz state as follows: "The vitamines pass into the milk only as they are present in the diet of the mother. Milk may vary in their growth promoting power when the diets of the lactating animals differ widely in their satisfactoriness for the growth of the young."

It has already been mentioned that through the industriousness of the animals themselves coupled with that natural instinct for self-preservation they have been able to hunt and balance their own feed when running at large but when they are brought under domestication and are artificially fed, then man's intelligence must necessarily replace their instinct and provide them with all the essential feeds and needs which they could have otherwise secured for themselves.

NOTES ON THE LICE OF DOMESTIC ANIMALS AT LOS BAÑOS

By H. E. WOODWORTH, *Professor of Entomology, College of Agriculture*

Since the removal of the College of Veterinary Science from Manila to Los Baños, and the organization of a course in Veterinary Entomology by the Department of Entomology of the College of Agriculture, several interesting cases of pediculosis have been brought to my attention which aroused my interest in these important animal parasites. Being unable to find references in Philippine entomological literature concerning the occurrence or relative importance of the various species of biting lice of domestic animals here and but the most meagre notes on species of sucking lice,[1] I have been tempted to publish the following scant notes, hoping that further collections will be made in all parts of the Islands, and more definite knowledge obtained as to the importance of these parasites of livestock in the Philippines. My thanks are due to Professor G. F. Ferris for his determinations of those species for which, because of unusual occurrence or other reasons, I desired verification.

CHICKEN

Two species of biting lice are extremely abundant on chickens around Los Baños. No chickens were found without a fairly heavy infestation and by for the majority were literally covered with the pests. The Common Hen Louse (*Menopon gallinae* L.),[1] which is considered as the most abundant of all lice infesting poultry, was found scarcely more numerous than the more infrequently met with Chicken Goniodes (*Goniodes dissimilis* Nitzsch).[1] The latter species has been considered of rather rare occurrence but judging from the lice infested chickens examined in Los Baños, it is nearly if not actually as abundant as the Common Hen Louse here. The effect of heavy infestations is easily recognized and effort should be made to keep the flocks comparatively free of these important pests.

[1] Banks, C. S., Blood-Sucking Insects of the Philippines. Philippine Journal of Science, Vol. XIV, No. 2, pp. 169–189, 1919.

DUCK

A few specimens of what is undoubtedly the Squalid Duck Louse (*Lipeurus squalidus* Nitzsch.) have been received with the note that they had been collected from ducks at Mayundon (a barrio of Los Baños). Although but few specimens have been collected here, it is probably much more abundant than the collections would indicate.

GOOSE

A single specimen of *Lipeurus jejunus* Nitzsch. is in the collection of the College of Agriculture. While the host is not indicated, this species seems confined to the goose family and probably was collected from a domestic goose. More extensive collections may reveal its relative abundance.

TURKEY

The Turkey Louse (*Lipeurus polytrapezius* Nitzsch.) appears quite frequently on turkeys around Los Baños. This species is one of the most common of turkey infesting lice and has a wide distribution. Peculiarly, none of the other common turkey lice have been collected here. This louse is quite harmful to young turkeys here, being responsible for their death in some instances.

PIGEON

The Pigeon Lipeurus (*Lipeurus baculus* Nitzsch.) is found heavily infesting pigeons around Los Baños and Pansol. This is a cosmopolitan species and is easily recognized by its extreme slender appearance.

GUINEA PIG

The Guinea Pig Louse (*Gyropus gracilis* Nitzsch.) has been collected in large number from the Guinea Pigs kept on the campus of the College of Agriculture. A very common species on this host in many localities.

SHEEP

Sheep kept near Pansol, Laguna, were found rather heavily infested with the Sheep Louse (*Trichodectes sphaerosephalus* Nitzsch.). In a few instances this louse had proven a rather troublesome pest and somewhat difficult to control, owing to the heavy wool of the host. It is a species which is not often reported.

GOAT

Both the Sucking Goat Louse (*Haematopinus stenopsis* Burm.)[1] and the Biting Goat Louse (*Trichodectes climax* Nitzsch.) have been collected from goats around Los Baños. The latter species is represented in the collection by a single specimen. *H. stenopsis*, however, has been found in large numbers on the neck, shoulders, and hind quarters of young goats kept on the campus of the College of Agriculture. Apparently this species has been rarely found in the past. It is interesting to note that it has also been recorded from goats in Mozambique.[2] Piaget[3] also records it from the antilope (*Antilope rupicapra*), although he states that he himself does not know this species. Osborn,[4] writing in the United States, states that "we have no record of this species having been observed in this country, and judging by references to it in standard works it must be of rather rare occurrence in countries where these animals are kept in greater abundance than here." Goats are not kept in the Philippines in any great numbers, and the presence and abundance of this louse here is therefore of unusual interest.

SWINE

The common Hog Louse (*Haematopinus suis* L.)[1] is present here as it is almost everywhere else. No serious cases of infestation have been noted here although this pest has been reported as an important parasites of swine at times in other countries.

DOG

A species of *Trichodectes* has recently been brought to my attention and I have forwarded specimens to the States for specific determination. This louse was found infesting a young puppy and occurred in such abundance as to seriously affect the health of the animal. Apparently it is not *T. latus*, the common biting louse of the dog.

CARABAO

Carabao throughout the Islands are infested with the Carabao or Buffalo Louse (*Haematopinus tuberculatus* Berm.).[1] Speci-

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[1] Determined by Prof. G. F. Ferris, Stanford University.

[2] Fernandez, J., Boletin da Reparticao de Agriculture, Nos. 19–21, Oct.–Dec., 1914, pp. 278–280.

[3] Piaget E., Les Pediculines, 1880, p. 648.

[4] Osborn, H., Insects Affecting Domesticated Animals. USDA. Bull. 5 n. s. 1896, p. 170.

mens have been received from various parts of Luzon and also from Central Mindanao through the kindness of Professor C. F. Baker. The severity of the infestations on carabao calves and the possibilities relative to the transmission of rinderpest, make this louse one of more than passing importance.

CATTLE

Several Hereford cattle on the College Farm have been found infested with the Short-nosed Ox Louse (*Haematopinus eurysternus* Nitzsch). This louse is a common and sometimes rather serious pest of cattle throughout the world, and often very difficult to control. Infestations should be promptly treated. Undoubtedly the other common lice of cattle, the Long-nosed Ox Louse (*Haematopinus vituli* L.) and the Biting Louse (*Trichodectes scalaris* Nitzsch.), will be found here, but so far neither of the last-named species have come to my attention.

HORSE

A number of specimens of the Biting Horse Louse (*Trichodectes parumpilosus* Piaget)[1] were obtained from the neck of a native pony left at the clinic of the College of Veterinary Science for treatment. So far this is the only horse infesting species that has been obtained at Los Baños.

LIST OF THE SPECIES OF LICE COLLECTED AT LOS BAÑOS

Chicken:
- *Menopon gallinae* L.
- *Goniodes dissimilis* Burm.

Duck:
- *Lipeurus squalidus* Nitzsch.

Goose:
- *Lipeurus jejunus* Nitzsch.

Turkey:
- *Lipeurus polytrapezius* Nitzsch.

Pigeon:
- *Lipeurus baculus* Nitzsch.

Guinea pig:
- *Gyropus gracilis* Nitzsch.

Goat:
- *Trichodectes climax* Nitzsch.
- *Haematopinus stenopsis* Burm.

Sheep:
- *Trichodectes sphaerocephalus* Nitzsch.

Hog:
- *Haematopinus suis* L.

Dog:
- *Trichodectes* sp.

Carabao:
- *Haematopinus tuberculatus* Burm.

Cattle:
- *Haematopinus eurysternus* Nitzsch.

Horse:
- *Trichodectes parumpilosus* Piaget.

[1] Determined by Prof. G. F. Ferris, Stanford University.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE

MANILA, *October 27, 1921.*

ADMINISTRATIVE ORDER }
No. 14. }

1. Cattle embarked at Australian ports, except as provided in General Order No. 1, series 1911–12, dated July 11, 1911, may be discharged and landed for slaughter only at the stockyards of the Bureau of Agriculture at Sisiman Bay, Province of Bataan, and nowhere else in the Philippine Islands.

2. Proper entry of the vessel will be made with the Collector of Customs in Manila before any cargo can be discharged. The usual inspection of the imported cattle will be made by a representative of the Director of Agriculture and the regular inspection fee of twenty centavos per head will be charged.

3. Owners of livestock will unload, drive, feed, and butcher cattle, besides being responsible for transporting the meat to Manila. The conditions under which the meat is kept during transportation shall be satisfactory to the Director of Agriculture, but the owner shall not be relieved of the responsibility of landing the meat in Manila in wholesome condition, conforming to food inspection requirements. All dead animals, condemned carcasses, and parts, will be disposed of by the Director of Agriculture, with the reservation that the owner be responsible for disposing of dead animals pending the installation of suitable apparatus for disposing of same.

4. The Superintendent of the Sisiman Stockyards and Matadero will have charge of all operations carried on therein, including the general system of butchering and dressing. There will be charged a fee for slaughtering animals amounting to three centavos per kilo of dressed meat, including livers, hearts, and tongues, removed for sale or consumption, but no fees will be collected on condemned meat. Each piece of meat will be weighed by the Superintendent and marked with tags showing the weight, together with the name and address of the consignee if so desired by the owner. The Superintendent will make a daily statement showing the number of pieces, weight of each,

and gross weight of meat removed by each owner, forwarding the same daily direct to the Director of Agriculture.

5. Fees shall be paid to the cashier of the Bureau of Agriculture on the first and sixteenth days of each month.

6. Each owner or importer shall deposit with the Director of Agriculture a bond executed by a reputable bonding company for the sum of ten thousand pesos (₱10,000), Philippine currency, as security for the payment of the sums or amounts due from such owner or importer for the fees herein required.

7. Meat shall be discharged at a point on the Pasig River designated by the Collector of Customs and further delivery will be made in exactly the same manner as meat is delivered from the Manila Matadero to various parts of the city, the owner paying the usual transportation fees to the City of Manila.

8. The Director of Agriculture reserves the right to slaughter at Sisiman any cattle diseased or exposed to disease when, in his judgment, this is necessary to protect the live-stock interests of the Philippine Islands in general. In such event all precautions possible will be observed to prevent losses from infectious diseases of cattle, but the Government of the Philippine Islands disclaims all responsibility for such losses from cattle diseases.

9. General Order No. 6, dated April 13, 1912, is hereby repealed.

(Sgd.) ADN. HERNANDEZ,
Director of Agriculture.

APPROVED, *November 2, 1921:*
(Sgd.) RAFAEL CORPUS,
Secretary of Agriculture and Natural Resources.

FIFTH PHILIPPINE LEGISLATURE, Special Session of 1922. } H. No. 1278.

[No. 3052]

AN ACT TO AMEND SECTION SEVENTEEN HUNDRED AND SIXTY-TWO OF ACT NUMBERED TWENTY-SEVEN HUNDRED AND ELEVEN, KNOWN AS THE ADMINISTRATIVE CODE, AND FOR OTHER PURPOSES.

Be it enacted by the Senate and House of Representatives of the Philippines in Legislature assembled and by the authority of the same:

SECTION 1. Section seventeen hundred and sixty-two of Act Numbered Twenty-seven hundred and eleven, known as the Administrative Code, is hereby amended to read as follows:

"SEC. 1762. *Bringing of animals imported from foreign countries into the Philippine Islands.*—It shall be unlawful for any person or corporation to import, bring or introduce live cattle into the Philippine Islands from any foreign country. The Director of Agriculture may, with the approval of the Head of the Department first had, authorize the importation, bringing or introduction of various classes of thoroughbred cattle from foreign countries for breeding the same to the native cattle of these Islands, and such as may be necessary for the improvement of the breed, not to exceed five hundred head per annum: *Provided, however,* That the Director of Agriculture shall in all cases permit the importation, bringing or introduction of draft cattle and bovine cattle for the manufacture of serum: *Provided, further,* That all live cattle from foreign countries the importation, bringing or introduction of which into the Islands is authorized by this Act, shall be submitted to regulations issued by the Director of Agriculture, with the approval of the Head of the Department, prior to authorizing its transfer to other provinces.

"At the time of the approval of this Act, the Governor-General shall issue regulations and orders to provide against a raising of the price of both fresh and refrigerated meat. The Governor-General also may, by executive order, suspend this prohibition for a fixed period in case local conditions require it."

SEC. 2. This Act shall take effect six months after approval.

Approved, March 14, 1922.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF AGRICULTURE

MANILA, *May 29, 1922.*

ADMINISTRATIVE ORDER
No. 18

Regulations governing livestock importation as provided in Act No. 3052, restricting the importation of cattle and carabaos from foreign countries to only those wanted for work and breeding and for the manufacture of anti-rinderpest serum.

1. On and after September 15, 1922, no cattle or carabaos shall be imported from any foreign port without a written permit issued by the Director of Agriculture. Any person or corporation desiring to import carabaos or cattle from any foreign port shall file an application with the Director of Agriculture, stating the number of head, the name of the port of origin, kinds of animals, the purpose for which they are to be used (whether for breeding work or manufacture of serum), the date when the contract was made, and the probable date of shipment. The application must be accompanied by a properly executed bond of not less than one hundred pesos (₱100) per head to insure that the importers will bring in only the kind or kinds of animal specified in the permit. In case the animals imported upon arrival are found to be unsuited for the purpose for which they were imported, either the bond shall be forfeited or the importer shall be required to return said animals to the port of origin. In order to fully comply with the purpose and intention of the law, every importer of animals for serum shall show to the satisfaction of the Director of Agriculture the number of animals needed for the amount of serum which ordinarily said importer sells per month.

2. The number of carabaos and cattle imported from all foreign ports for breeding purposes shall not exceed 500 heads in any single year.

3. The sanitary requirements for the importation of cattle for breeding purposes from Australia shall be those contained in General Order No. 1, series 1911–1912, dated July 11, 1911 of the Bureau of Agriculture.

4. Carabaos or cattle imported from French Indo-China, Hongkong, British India, or any other rinderpest infected country, shall be required to undergo immunization against rinderpest by the simultaneous method at the Bureau of Agriculture quarantine stations at the risk and expense of the owner and only by a duly authorized veterinarian of the Bureau of Agriculture before they are taken out of the quarantine stations.

5. Carabaos or cattle for breeding purposes imported from any port of British India shall be received at the Pandacan Quarantine Station in the City of Manila, or at any other place designated by the Director of Agriculture.

6. Carabaos and cattle imported from Hongkong and from the ports of French Indo-China for work purposes shall be landed either at the Pandacan Quarantine Station in the City of Manila or at the Lapus-lapus Quarantine Station in Iloilo, or at any other quarantine station that may be designated by the Director of Agriculture.

7. Bovine cattle imported from Hongkong or the ports of French Indo-China to be used for the manufacture of serum shall be received only at the Pandacan Quarantine Station in Manila where they must be kept at all times until they are finally disposed of by slaughter.

8. The sanitary requirements for the importation of cattle and carabaos for breeding, work, or serum manufacture from other foreign ports not regulated in this order shall be as prescribed in General Order No. 68, dated September 17, 1919 of the Bureau of Agriculture.

9. All orders or parts of orders now in force which are in conflict herewith are hereby repealed.

10. This order shall take effect on September 15, 1922.

(Sgd.) ADN. HERNANDEZ,
Director of Agriculture.

Approved:

(Sgd.) RAFAEL CORPUS,
Secretary of Agriculture and Natural Resources.

MINUTES OF THE TENTH ANNUAL MEETING OF THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION

The tenth annual meeting of the Philippine Veterinary Medical Association was held on February 5, 1922, in the office of the Bureau of Agriculture, Manila.

The meeting was called to order at 9.30 a. m., Dr. V. Ferriols presiding.

Dr. San Agustin moved to dispense with the reading of the minutes. Dr. Panganiban seconded. Motion, carried.

After the roll-call, the Secretary-Treasurer read a report on the financial condition of the Association which was approved by acclamation.

The following applications for new memberships were presented:

1. Dr. Romarico Barber, graduate of the College of Veterinary Science, 1921.
2. Dr. Gavino San Gabriel, graduate of the College of Veterinary Science, 1921.
3. Dr. Miguel Manresa, graduate of the College of Veterinary Science, 1921.

Dr. Generoso moved to approve these applications. Dr. San Agustin seconded. Motion was carried.

There were only two papers read in the meeting, one by Dr. Gregorio San Agustin, Assistant Professor in the College of Veterinary Science, on "Unidentified Dietary Essentials in the Ration of Domestic Animals" and the other by Dr. S. Youngberg, Chief Veterinarian, on "The History of Rinderpest in the Philippines." Both papers are published in this issue of the Agricultural Review.

The election for new officers for the year 1922 was then proceeded to and the following were elected:

President—Dr. Harry F. Kern.
Vice-President—Dr. Teodulo Topacio.
Secretary-Treasurer—Dr. A. K. Gomez (re-elected).

Dr. Gomez moved that a sum not to exceed ₱100 be appropiated from the funds of the Association for printing in pamphlet form the Constitution and Directory of the Philippine Veterinary Medical Association. Dr. San Agustin seconded. Motion, carried.

Dr. Villa moved to adjourn. Seconded by Dr. Alano. Carried. Meeting adjourned at 12 a. m.

THE PHILIPPINE

Agricultural Review

VOL. XV FOURTH QUARTER, 1922 No. 4

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TWENTY-FIRST ANNUAL REPORT OF THE BUREAU OF AGRICULTURE

SIR: I have the honor to submit herewith the Annual Report of the Bureau of Agriculture for the fiscal year ended December 31, 1921. As heretofore, however, all the statistical data contained herein are based on the agriculture year ending June 30th, unless otherwise specified.

PHILIPPINE AGRICULTURE

GENERAL SUMMARY

Compared with 1920, there was a slight decrease in the areas planted to tobacco and abaca, but the cultivation of edible crops, especially rice and sugar cane, was greatly extended, so that the total area grown to the six leading crops of the Philippines, namely, rice, corn, sugar cane, coconuts, abaca, and tobacco, exceeded by 7 per cent that for the preceding year, the record year in the history of Philippine agriculture. A new record was thus established in 1921, when the area totalled 3,515,587 hectares as compared with 3,276,942 hectares in 1920. Notwithstanding this appreciable increase in hectarage, the year was nevertheless one of general dissatisfaction from a financial standpoint. Of course the Philippines could not escape the disastrous effect resultant on the universal disturbance of values brought about by the world war. The abaca market continued declining gradually from 1919, and the tobacco from about the middle of 1920, just before the planting season, resulting in a decrease in hectarage for these two crops. On the other hand, influenced by the record prices prevalent during 1919–20, the area subsequently planted to rice was increased by 12.7 per cent, to sugar cane 22.3 per cent, to coconuts 5.3 per cent, and to corn 1.2 per cent. In yield per hectare, 1921 shows also an increase of 1.2 per cent for rice and 3.4 per cent for sugar over that for the corresponding crops in 1920, but market conditions went from bad to worse, so that in spite of the increases in area and yield the value of Philippine productions for all the six leading crops fell from ₱687,131,502 in 1920 to ₱403,258,251 in 1921, or a decrease of fully 41 per cent. The seriousness of this

situation may be more fully appreciated if the fact that our 1921 crops were raised at extraordinarily great expense, principally because of the high rates of wages prevailing during their cultivation, is taken into consideration.

The following table shows the development of the country's agriculture in the last twelve years, 1921 included, as regards the six leading crops:

Area and value of the six leading crops

Year	Area in hectares	Per cent of increase or decrease	Value	Per cent of increase or decrease	Average value per hectare
1910	2,256,532	....	₱137,005,956	....	₱61
1911	2,148,238	— 5	152,501,515	+11	71
1912	2,303,875	+ 7	148,347,499	— 3	64
1913	2,361,483	+ 3	168,633,730	+14	71
1914	2,579,994	+ 9	163,496,249	— 4	63
1915	2,522,208	— 2	159,055,329	— 3	63
1916	2,531,701	+ 4	179,241,378	+13	71
1917	2,691,412	+ 6	244,179,473	+36	91
1918	2,918,590	+ 8	361,940,449	+48	124
1919	2,974,925	+ 2	458,698,576	+27	154
1920	3,276,942	+10	687,131,502	+50	210
1921	3,515,587	+ 7	403,258,251	—41	115

STANDARD CROPS

Rice.—Because of the restrictions placed in 1919 by the French Government on the exportation of rice from Indo-China, the country upon which these Islands depend in times of local shortage, because of the high prices that it has been commanding in recent years and because it is the national food of the Filipino people, the rice industry received unusual attention from the farmers this year.

Rains came generally late this season and when they did come were too heavy for the young seedlings and floods washed out newly planted crops in many places. In the majority of cases, however, the farmers succeeded in replanting the destroyed areas and raising a crop.

As will be seen from Table II, 1,673,381 hectares were planted during the year. This is 12.7 per cent greater than the area for the previous year, 33.9 per cent greater than the average for 5-year war period of 1915–19, and 46.8 per cent greater than the 5-year pre-war average, 1910–14. Of said area, 1,132,668 hectares or 67.7 per cent were of lowland rice. The total production was 3,110,890,500 liters or 41,478,540 cavans of rough rice. This is 14.1 per cent greater than 1920's, and 51.9 per cent and 111.1 per cent in excess of the average productions during the war and pre-war periods, respectively. Of this production, 2,273,106,300 liters (30,308,084 cavans) or 73.1 per cent were of lowland rice and 837,784,200 liters (11,170,456

cavans) or 26.9 per cent upland. The value, however, fell 38.4 per cent as compared with that for the preceding year, as it was only ₱156,892,680.

Nueva Ecija, Pangasinan, Iloilo, Tarlac, Pampanga, Ilocos Norte, Bulacan, La Union, and Batangas are the leading provinces, in the order of their importance, as regards area cultivated. Nueva Ecija this year replaced Pangasinan at the top of the list. A similar change is also noted in the case of Pampanga and Ilocos Norte, which this year occupy fifth and sixth place, respectively; while Batangas jumped from the thirteenth to the ninth place, replacing Ilocos Sur. These nine provinces had 906,648 hectares or 54.2 per cent of the total rice of the Philippines, with a production aggregating 1,982,126,175 liters (26,428,349 cavans) or 63.7 per cent of the total. Only 27.8 per cent of the crop in these provinces was upland rice.

The total area cultivated in the Islands, the production, the average price and the total value of this cereal since 1910, are given in the following table:

TABLE II

Year	Area cultivated	Production	Average price per cavan	Total value
	Hectares	*Cavans*		
1910	1,192,141	18,859,086	₱3.01	₱55,765,849
1911	1,043,757	20,530,096	3.01	61,795,589
1912	1,078,891	11,622,468	3.44	39,981,288
1913	1,141,242	24,498,858	2.37	57,939,799
1914	1,244,937	22,736,814	2.52	57,261,760
1915	1,130,713	17,818,491	2.76	49,207,978
1916	1,140,829	20,878,864	2.68	55,923,821
1917	1,225,692	28,276,717	2.85	81,377,812
1918	1,368,140	35,795,046	3.77	135,163,375
1919	1,381,339	33,781,649	5.58	188,614,588
1920	1,484,895	36,343,808	7.01	254,855,385
1921	1,673,381	41,478,540	3.78	156,892,680

NOTE.—1 cavan = 75 liters = 43 kilos.

Sugar cane.—A new record as regards both area and production was established in the sugar industry of the Islands, during the year under consideration. In area, this year's crop was 22 per cent greater than 1920's, while in production 26 per cent. These increases are much greater than those registered for rice.

From 241,345 hectares cultivated there were harvested 510,171,338 kilos of sugar, 24,562,505 kilos of panochas, 8,039,591 liters of basi, and 7,524,745 liters of molasses, all valued in the municipal markets at only ₱96,378,980, as against ₱159,257,117 for 1920—a loss in value of fully 39 per cent in spite of the great increases in both hectarage and total production. The production of sugars by classes was as follows: refined, 5,123,250 kilos; centrifugal, 179,156,637 kilos; muscovado, 325,891,451

kilos. A close comparison of the amounts of the different classes of sugars obtained this year with those of the previous crop, reveals the influence of the centrals in the sugar industry of these Islands. During the 1919–20 campaign the proportion of refined sugar did not reach even 0.1 per cent, while this year it was exactly 1 per cent; the centrifugal sugar advanced from 21 per cent in 1920–21 and the muscovados fell from 79 per cent to 64 per cent, respectively.

The 1921 prices in the municipal markets, as compared with those of the preceding year, were as follows: refined, ₱0.51 per kilo or ₱32.47 per picul against ₱0.63 per kilo or ₱40.00 per picul; centrifugal, ₱0.23 per kilo or ₱14.24 against ₱0.45 per kilo or ₱28.18 per picul; muscovados, ₱0.14 per kilo or ₱8.90 per picul against ₱0.35 per kilo or ₱22.45 per picul; and panochas ₱0.19 per kilo or ₱11.96 per picul against ₱0.30 per kilo or ₱18.95 per picul.

Sixty-seven per cent of the total area cultivated and 76 per cent of the country's sugar production came from the four provinces of Occidental Negros, Pampanga, Batangas, and Iloilo. These provinces turned out 141,600,748 kilos of centrifugal sugar and 243,884,916 kilos of muscovado.

The following table shows the area cultivated, production and total value of all by-products of sugar cane since 1910:

TABLE III.—*Sugar cane in the Philippines*

Year	Area cultivated	Sugar	Panocha	Total value of sugar cane products
	Hectares	*Kilos*	*Kilos*	
1910	83,168	152,639,327	(1)	₱15,263,933
1911	120,313	243,924,574	(1)	24,392,457
1912	164,261	242,334,659	12,908,359	26,428,626
1913	176,118	291,386,825	21,664,663	25,698,450
1914	169,436	346,429,556	24,013,110	28,631,545
1915	173,092	360,176,309	21,926,350	33,212,488
1916	179,761	350,281,946	23,730,795	34,136,133
1917	185,931	362,338,084	23,460,746	38,704,708
1918	205,511	396,242,786	34,442,908	41,158,779
1919	200,199	379,127,229	32,145,430	74,462,819
1920	197,403	391,862,971	31,717,282	159,257,117
1921	241,345	510,171,338	24,562,505	96,378,980

[1] Sugar not classified prior to 1912.

Coconuts.—With the sole exception of 1913, when an unusually prolonged, intense drought caused great damage to coconut plantations, and was followed by a series of destructive typhoons which resulted in the destruction of over one million and a half trees, every year since 1910 has shown an increase over that preceding, so that in 1921 there were over two and a half times (255 per cent) as many coconut trees in the Phil-

ippines as there were eleven years before. Naturally the copra production has also increased.

On June 30, 1921, there were in the Islands 83,591,896 trees cultivated, of which 47,009,080 or 56.2 per cent were in bearing. The nuts on about 1.2 per cent of these latter, however, were not allowed to mature as the sap was used for making tuba. The production of nuts was 1,547,583,132. This was 2.5 per cent greater than the production for 1920, although the trees average a yield of only 33 nuts each against 35 per tree in 1920. This decrease was due to the damage received by the plantations from typhoons especially during the latter part of 1920, and also to the fact that a large number of young trees bore nuts for the first time.

Of the total nuts gathered during the year, 92.8 per cent were made into copra, 1.8 per cent used for the making of oil, and the remaining 5.4 per cent were used for domestic purposes. There were 374,622,476 kilos or 5,922,885 piculs of copra, 2,706,723 liters of oil (home-made) and 103,854,736 liters of tuba made during the season. Of the copra produced, 181,022,575 kilos or 48.3 per cent of the total were sundried; 192,626,041 kilos or 51.4 per cent were smoked or "tapahan" copra, and 973,860 kilos or 0.3 per cent were steam and hot-air dried copra.

The prices of the different grades of copra and of the other by-products of coconuts as compared with those of the preceding year were as follows: sundried copra, ₱0.15 per kilo against ₱0.31; smoked copra, ₱0.17 per kilo against ₱0.29; steamed copra, ₱0.11 per kilo against ₱0.30; fresh nuts, ₱4.73 per 100 against ₱6.70; coconut oil, ₱0.53 per liter against ₱0.59; tuba, ₱0.11 per liter against ₱0.14. Because of these greatly reduced prices, the total coconut production this year was valued at only ₱76,192,530, whereas in 1920, with a smaller production, the respectable sum of ₱128,196,891 was realized.

The six leading coconut producing provinces according to the number of trees cultivated were, in the order of their importance, Tayabas, Laguna, Cebu, Misamis, Samar, and Albay, which carry 55.9 per cent of the total trees planted in the Islands. Their combined production was 1,047,745,685 nuts and 258,324,005 kilos of copra, or 68 per cent and 69 per cent, respectively, of the corresponding totals for the Islands.

Tables IV, V, and VI show the total number of trees, the total number of nuts gathered, the total value of all products, the production of copra, oil, and tuba, and the average prices in the Archipelago since 1910.

TABLE IV

Year	Trees cultivated	Nuts gathered	Total value of coconut products
1910	32,838,544	937,927,927	₱26,161,629
1911	41,695,165	965,155,699	26,261,273
1912	46,136,349	1,041,181,904	35,926,543
1913	44,642,411	781,585,504	30,535,664
1914	49,190,368	591,266,399	24,651,764
1915	52,829,678	865,815,826	24,461,884
1916	54,153,847	735,275,751	24,430,955
1917	60,244,047	880,588,806	31,975,494
1918	67,120,399	1,506,796,110	56,533,793
1919	74,650,102	1,454,950,603	75,438,291
1920	79,406,104	1,509,504,293	128,196,891
1921	83,591,896	1,547,583,132	76,192,530

TABLE V

Year	Nuts consumed for food	Copra	Oil (home-made)	Tuba
		Kilos	*Liters*	*Liters*
1910	311,609,148	118,140,822	6,993,513	174,483,484
1911	154,980,726	118,323,114	6,602,966	37,649,880
1912	96,262,490	174,035,835	4,868,101	39,842,911
1913	147,981,014	116,699,818	5,010,540	42,145,874
1914	63,057,700	107,382,931	3,595,332	54,048,393
1915	72,441,158	171,573,963	3,175,626	51,372,213
1916	63,818,406	141,764,193	2,688,305	53,938,612
1917	64,586,492	186,510,962	2,623,687	43,674,587
1918	91,612,157	346,656,535	4,555,330	83,922,804
1919	75,358,583	349,384,855	5,142,213	100,315,522
1920	84,216,092	361,605,373	2,879,452	98,068,843
1921	83,556,120	374,622,476	2,706,723	103,854,736

TABLE VI.—*Average prices*

Year	Nuts for food per 100	Copra per kilo	Oil per liter	Tuba per liter
1910	₱3.00	₱0.15	₱0.30	₱0.05
1911	3.00	.15	.30	.05
1912	3.00	.17	.30	.05
1913	4.00	.18	.30	.05
1914	4.00	.16	.34	.06
1915	2.90	.11	.21	.06
1916	3.41	.13	.26	.05
1917	3.73	.14	.32	.05
1918	3.63	.13	.30	.07
1919	4.39	.17	.36	.10
1920	6.70	.30	.59	.14
1921	4.73	.16	.53	.11

Corn.—With an increase of 1.2 per cent in area, this product held the distinction this year of occupying the fourth place in hectarage among the leading crops of the Philippines. The production, however, was even less than that of last year due to adverse weather conditions which caused a decrease of 6.6 per cent in the average yield per hectare. In value, this year's crop is also less than last year's, not only because of this decrease in yield per hectare but of the great fall in the price of this commodity.

Five hundred and forty-three thousand eight hundred and twenty-eight hectares were put under cultivation and yielded

516,299,700 liters of shelled corn which were sold for ₱38,187,266. The area planted this year was the largest ever planted, it being 26 per cent larger than the average area for the 5-year period of the great war (1915–19) and 57 per cent larger than that for the 5-year period (1910–14) immediately preceding the war. The production was larger too by 12 per cent than the 1915–19 average, and by 79 per cent than that for 1910–14, but was exceeded by 7 per cent in 1919–20.

Sixty and nine tenths per cent of the total area cultivated and 64.5 per cent of the total production was carried by six provinces alone. These were Cebu, Isabela, Leyte, Occidental Negros, Oriental Negros, and Bohol, named in the order of their importance.

Data on the total area cultivated, the total production, the average price, and the total value of this grain in the Islands since 1910, are given below.

TABLE VII

Year	Hectares	Liter	Price per liter	Value
1910	288,268	185,068,056	₱0.046	₱8,661,185
1911	302,516	186,404,700	.047	8,723,740
1912	340,196	274,964,929	.047	12,868,359
1913	383,709	325,450,460	.047	15,231,082
1914	421,309	469,270,874	.034	15,873,804
1915	443,048	518,126,873	.031	16,067,658
1916	432,766	496,270,874	.030	14,723,962
1917	428,293	473,659,035	.037	17,639,800
1918	418,386	397,177,773	.053	21,372,123
1919	430,715	426,456,940	.087	37,591,423
1920	537,135	552,907,350	.092	50,910,867
1921	543,828	516,299,700	.074	38,187,266

Abaca.—This important Philippine fiber, which for years occupied the second place among the leading crops of the Islands in the order of value of production, was ousted by sugar cane in 1919, by coconuts in 1920, and this year passed even by corn, so that now it occupies the fifth place only. This is due to the distressingly steady fall in prices, which began declining the last year of the war, when the prices for all other articles advanced tremendously. As a result of these discouraging market conditions, and adverse labor and climatic disturbances, many planters have turned their attention to the cultivation of other crops such as rice, corn or sugar, utilizing in many cases old abaca plantations and areas destroyed by typhoons and droughts.

The area under cultivation of this product this year was 548,094 hectares which was 2 per cent smaller than that of last year. The greatest decrease was registered in the average yield per hectare, and consequently in the total production, which were 385 kilos and 108,353,530 kilos, respectively. This pro-

duction—the smallest production in the record of twelve years of the Bureau of Agriculture—was 34.4 per cent less than that of 1920. With such a considerable reduction in the total output and with the lowest quotation registered in the last five years, it is no wonder that the value was only ₱26,829,221 or 57.5 per cent less than that obtained last year which was 3 per cent less than the corresponding for 1918–19, which in turn was 30 per cent still smaller than that for 1917–18, when the total value of the Philippine abaca crop reached the highest mark ever known.

The principal abaca producing provinces in the order of hectarage are Leyte, Albay, Sorsogon, Camarines Sur, and Samar. These have altogether 367,366 hectares planted or 67 per cent of the total abaca area cultivated of the Islands and produced this year 72,432,870 kilos of fiber or 67 per cent of the total production.

The following table shows the total area cultivated, the production, average price per kilo, and the total value of this product since 1910:

TABLE VIII

Year	Hectares	Kilos	Price per kilo	Value
1910	475,136	168,452,144	₱0.16	₱26,952,343
1911	404,160	171,879,598	.16	27,500,736
1912	432,804	159,473,376	.18	28,705,208
1913	368,211	140,520,332	.23	32,319,676
1914	437,470	137,635,558	.22	29,968,009
1915	457,865	154,192,492	.20	30,420,742
1916	448,663	152,756,278	.28	42,767,338
1917	488,500	160,953,355	.39	63,598,136
1918	512,508	166,863,644	.55	92,493,224
1919	515,563	148,340,800	.45	65,006,006
1920	559,356	165,081,488	.38	63,058,847
1921	548,094	108,353,530	.25	26,829,221

Tobacco.—With a decrease of 10 per cent in the area cultivated and 18.7 per cent in the production of this year as compared with the preceding year, tobacco came sixth in rank of value among the chief crops of these Islands.

These decreases were due to the same causes that affected abaca, that is, low prices, drought, and heavy rains, and for the same reasons part of the area that was used for planting tobacco was this year grown to rice and sugar cane.

The area cultivated was only 90,980 hectares, yielding 52,799,030 kilos of leaf tobacco, which was valued in the municipal markets at ₱8,777,574 or 17 centavos per kilo.

Despite these unfavorable results, the area planted for this year was 39.4 per cent greater than the average for the 5-year period of war (1915–19), and 46.9 per cent greater than that

for 5 years (1910–14) immediately preceding the war; while the production was larger by 7.1 per cent and 50 per cent, respectively.

Practically three-fourths of the total area and over four-fifths of the total production were planted and gathered in only five provinces, to wit: Isabela, Cagayan, Cebu, Pangasinan, and La Union. During the year these provinces put under cultivation 68,023 hectares and raised 43,999,966 kilos.

The following table gives the annual hectarage, production, average price, and total value of this crop in the Islands since 1910:

TABLE IX

Year	Hectares	Kilos	Price per kilo	Value
1910	53,626	28,006,778	₱0.15	₱4,201,017
1911	69,016	25,518,132	.15	3,827,728
1912	57,041	29,583,169	.15	4,437,475
1913	68,991	46,060,390	.15	6,909,059
1914	60,890	46,731,463	.15	7,109,367
1915	53,342	38,302,964	.15	5,684,579
1916	58,913	41,139,174	.18	7,259,169
1917	61,776	48,928,621	.22	10,883,523
1918	78,443	61,555,322	.25	15,219,155
1919	73,859	56,497,748	.31	17,585,449
1920	101,123	64,893,534	.41	26,765,947
1921	90,980	52,799,030	.17	8,777,574

Maguey.—Being so closely commercially allied, the maguey industry suffered in practically the same manner as did the abaca. The hectarage of last year was reduced by 0.6 per cent, the production by 49.5 per cent and the total value by 69.1 per cent.

Leading in the cultivation of this fiber were Cebu, Ilocos Sur, Ilocos Norte, Bohol, and Pangasinan. Their aggregate area last year was 28,658 hectares or 93 per cent of the total area, with a production of 8,981,745 kilos or 97.9 per cent of the country's production.

Table X gives the area cultivated, the production, the average price per kilo and the total value of this crop since 1912, when the Bureau began compiling statistics thereon.

TABLE X

Year	Hectares	Kilos	Price per kilo	Value
1912	8,598	4,628,331	₱0.12	₱555,399
1913	9,283	3,619,976	.13	470,596
1914	18,218	7,583,802	.11	860,754
1915	19,218	6,315,632	.10	622,587
1916	30,804	13,389,722	.13	1,747,263
1917	28,099	17,190,019	.19	3,363,381
1918	32,601	16,664,736	.22	3,707,213
1919	28,465	12,318,392	.16	1,919,750
1920	30,567	18,178,050	.19	3,407,959
1921	30,385	9,177,470	.11	1,054,261

Miscellaneous field crops and vegetables.—To meet the economic crisis which followed the cessation of the world war, this office spared no efforts in campaigning, through its field force and by other means, for the production of larger quantities of food substitutes in order that the cost of living might be diminished. The results will be seen below.

One hundred and forty-seven thousand four hundred and eigthy-three hectares were planted to different edible crops and yielded the aggregate amount of 316,201,668 kilos of foodstuffs, valued in the municipal markets at ₱11,081,025. Compared with the results obtained in the preceding year, there was a decrease of 1 per cent in the area cultivated and 12 per cent in the total value due to the general fall in prices, but an increase of 18 per cent in the production.

The principal crops were sweet potatoes, worth over ₱3,000,000; mongo and gabi, over ₱1,000,000 each; and tomatoes, ubi, eggplants, cassava, and beans, over half-million pesos each.

In the follownig table are listed thirteen selected vegetable and root crops and the area cultivated, the production and the value of each during the year under review.

TABLE XI

Crops	Hectares	Kilos	Value
Sweet potatoes	63,561.20	191,022,005	₱3,240,811
Mongo	12,671.10	11,163,523	1,747,882
Gabi	10,016.90	38,703,956	1,240,397
Tomatoes	8,410.60	8,383,569	838,177
Ubi	5,972.90	13,163,324	767,406
Eggplant	11,867.20	7,980,439	746,430
Cassava	15,077.60	29,383,654	657,210
Beans	8,690.80	2,481,710	546,736
Peanuts	5,151.50	1,807,932	477,105
Radishes	1,792.00	4,029,678	395,219
Cabbages	1,118.80	1,778,119	262,867
Tugui	2,830.90	6,137,004	140,122
Irish potatoes	322.40	166,755	20,663
Total	147,483.90	316,201,668	11,081,025

Fruit production.—The fruit industry in these Islands in general is greatly neglected and in fact there are very few plantations that are entitled to that designation. In spite of this, fruits brought the growers the respectable amount of ₱35,883,813, which represents, if compared with the previous year, an increase of 32 per cent.

Among the leading fruits, bananas and mangoes registered the greatest increases in both production and value.

The following table, showing a list of various fruits and the number of trees cultivated, production and value of each, will

give an idea of the considerable wealth that could be acquired if these trees were properly cared for:

TABLE XII

Fruits	Number of trees	Production	Value
Bananas	55,470,870	53,652,382 bunches	₱24,759,081
Mangoes	566,349	126,510,281 fruits	4,693,904
Cacao	1,656,253	888,940 kilos	1,267,700
Papayas	3,594,400	51,031,875 fruits	1,236,973
Coffee	2,096,487	1,062,298 kilos	1,054,385
Lanzones	139,005	....	828,993
Pilinuts	275,996	3,652,795 kilos	436,403
Pineapples	8,300,254	6,132,266 fruits	336,632
Mandarins	356,007	19,730,366 fruits	267,197
Guanabano	603,422	7,232,238 fruits	265,110
Oranges	209,447	8,767,845 fruits	229,761
Ates	1,225,486	15,400,513 fruits	225,908
Pomelos	212,680	4,475,038 fruits	105,656
Anonas	376,119	6,757,398 fruits	102,357
Chicos	50,296	6,663,420 fruits	73,753
Total	....	....	35,883,813

Livestock.—As an animal census is taken only once a year, on December 31, it is only possible here—as in the previous animal reports—to give the data for the preceding year.

Notwithstanding the fact that the most dreaded cattle disease, the rinderpest, has been with us constantly since it appeared about twenty years ago, records kept since 1910 show a steady growth of the country's animal industry. Compared with the preceding year, 1920 figures show increases in stock as follow: carabaos, 13 per cent; cattle, 16 per cent; horses and mules, 15 per cent; hogs, 16 per cent; goats, 12 per cent; and sheep, 17 per cent. It must be stated, however, that a good part of these increases were due to the fact that many municipal districts in Mindanao and Sulu not reporting in previous years submitted their livestock reports for 1920.

For three consecutive years the birth rate of all animals went on declining, a fact that was set forth in the last annual report of the undersigned. Fortunately this did not continue during the year 1920 as a general rise was registered, especially for cattle, horses, and sheep. Comparing the rates of increases due to births for 1920 with the average for the 5-year period of 1915–19, we have the following contrasts: carabaos, 13.9 per cent against 11 per cent; cattle, 25.5 per cent against 20.1 per cent; horses and mules, 20.2 per cent against 15.7 per cent; hogs, 30.2 per cent against 29.7 per cent; goats, 23.3 per cent against 22.6 per cent; sheep, 29.3 per cent against 24.3 per cent. The death rate for all the above domestic animals, except the cattle, also increased in 1920, but the increase was negligible, it being only a small fraction of 1 per cent for cara-

baos, horses, goats, and sheep, and 3.8 per cent for swine. This extraordinary death rate for hogs is attributable to the series of typhoons and floods in 1919 and 1920, which actually drowned a large number of hogs and caused more diseases.

Table XIII gives the number of animals by the year for carabaos, cattle, horses and mules, swine, goats, and sheep, since 1910. By comparing the figures for the first and the last years it will be learned that, despite the neglect of owners and herdsmen, the annual losses from diseases and the careless methods employed in breeding, the livestock industry of these Islands is gradually progressing in numbers at least.

TABLE XIII

Year	Carabaos	Cattle	Horses
1910	705,758	243,180	138,199
1911	809,267	289,771	146,641
1912	911,318	337,202	162,383
1913	1,047,164	418,114	179,089
1914	1,147,433	477,736	215,826
1915	1,221,966	534,123	223,195
1916	1,228,836	567,456	203,364
1917	1,271,208	603,107	214,209
1918	1,338,082	601,297	234,041
1919	1,388,244	678,525	255,380
1920	1,570,609	786,166	294,638

TABLE XIV

Year	Hogs	Goats	Sheep
1910	1,637,338	422,185	88,805
1911	1,661,831	441,325	92,617
1912	1,735,047	476,638	97,640
1913	2,016,736	529,180	104,147
1914	2,285,880	592,042	118,010
1915	2,521,143	644,562	129,509
1916	2,734,803	661,859	142,091
1917	2,810,737	722,532	155,827
1918	2,894,403	741,077	165,686
1919	3,129,676	731,849	168,181
1920	3,639,183	821,661	195,705

PERSONNEL

The most important change in the personnel occurred on December 31st when Assistant Director Mack Cretcher severed his connection with the Government under Act No. 2589, better known as the Retirement Act, after over seven years of service in the Bureau of Agriculture.

From April 9 to September 9, during which period Mr. Cretcher was away from the Islands, he and Assistant Agronomist Jose S. Camus having gone to London to take the Bureau of Agriculture's exhibit to the Fifth International Exposition of Tropical Products and Allied Industries, Assistant Director Silverio Apostol, in addition to his special assignments, assumed

the duties of Assistant Director Cretcher as chief of the Administrative Division.

During the year the permanent personnel of the Bureau of Agriculture was increased by 34 employees, but the temporary was reduced by 134, thus resulting a net loss of exactly 100 employees. Among the Americans there was but one resignation, that of Assistant Director Cretcher's. On the other hand the temporary list was augmented by one appointment made during the second quarter.

ORGANIZATION

The Bureau functioned under essentially the same organization plan adopted on August 1, 1919, with thirteen divisional units; namely, the administrative, animal husbandry, veterinary, plant industry, demonstration and extension, plant pests control, fiber, animal insurance, rural credit, farm statistics, publications, accounting, and the property divisions.

ADMINISTRATIVE DIVISION

ACTIVITIES

(*a*) General Service.
(*b*) Records.
(*c*) Cashier and Disbursing Officer.
(*d*) Land Transportation.
(*e*) Repair Shop.
(*f*) Momungan Agricultural Colony.

GENERAL STATEMENT

In order to be better able to handle the large amount of correspondence attended to by the Bureau of Agriculture, on January 1, the method of recording was changed from the vertical filing system to the numerical system. This change has resulted in the prompter dispatch of correspondence, both letters sent and letters received. There was a decrease of 3 per cent in the total amount of correspondence during the year as compared with that for 1920. This was due mainly to the fact that at the beginning of 1921 the free distribution of seeds and plant materials was discontinued. Another change effected early in the year was the transfer of the supervision over the office of the Cashier and Disbursing Officer to the Administrative from the Accounting Division.

CORRESPONDENCE

The total correspondence registered during the year was 167,026, of which 46,814 were letters received and 120,212 letters sent (forms exempted from the count) as against 173,932 the

previous year. There were 8,384 letters delivered by messenger to the different departments, bureaus and other Government offices in the city of Manila. The assignment of one motorcycle to the record section greatly increased the efficiency of the delivering service both for the mail and otherwise. There were also 1,660 telegrams sent out by the Bureau during the year. The total cost of transmission of both these telegrams and the correspondence through the mails was ₱2,222.98 and ₱9,416.54, respectively, distributed among the different divisions as follows:

	Mail	Telegrams
Administrative Division[1]	₱171.28	230.46
Accounting	420.92	110.59
Property	198.06	123.20
Animal Husbandry	195.60	194.42
Plant Industry	674.34	311.21
Seeds	1,793.84	-------
Pest Control	282.22	196.70
Statistics	1,374.42	5.25
Fiber	416.12	290.94
Demonstration and Extension	429.14	157.95
Veterinary	447.12	521.44
Animal Insurance	638.30	52.77
Rural Credit	638.30	26.25
Publications	1,949.84	1.80
Total	9,416.54	2,222.98

[1] Including Momungan Agricultural Colony.

The total cost of transmission of correspondence and telegrams, therefore, during the year was ₱11,639.52. This is ₱2,306.29 less than that spent for these purposes in 1920.

TRANSPORTATION AND REPAIR

The repairs on all Bureau transportation and machinery and the repairing and manufacture of office furniture and equipments are done at the Singalong Repair Shop. The superintendent together with the mechanics makes a daily inspection of all the vehicles, cars, and trucks, before sending them to the central office. This section is also in charge of making minor repairs on buildings belonging to the Bureau. The carpentry work, such as the making of tables, cabinets, bookshelves, boxes, and packing cases for shipment and the like as well as blacksmith work is also done there. Some accessories for automobiles. motorcycles, and bicycles are made in the Singalong Repair Shop and thereby a great economy has been effected during the year. There were 128 serial and work orders for repair and manufacture of office furniture during the year, of which 127 were filled. There were 35 repair orders and 27 furnish orders for bicycles, 2 furnish orders for automobiles and 34 repair orders

and 70 furnish orders for motorcycles. The cost of the operation and maintenance of 8 passenger cars, 2 White trucks, 5 wagons, 7 carromatas, one calesa, 4 carretelas, and 24 native ponies and 6 mules and the consumption of gasoline, oil, grease, lubricants, motorcycles, and auto accessories and supplies including mixed feeds, barit grass, petroleum, etc. amounted to ₱29,837.39. Two of the native ponies died, 3 were transferred to other bureaus, and 7 were recommended to be condemned, as they were unserviceable on account of old age.

Besides the work in the repair shop in connection with vehicles and the general management and supervision of land transportation, this section also attends to the repair and supervision of the operation of Bureau tractors. Mechanics from this section were often sent to the provinces to inspect and make the necessary repairs to tractors and also to teach newly appointed men how to operate same.

This shop also performed repairs for the Bureau of Lands during the year 1921 on two automobiles, one motorcycle and one bicycle. The repairs and cost were as follows:

Auto Hupmobile No. P. I. 39	₱68.68
Auto Hupmobile No. P. I. 20	136.51
Auto Hupmobile No. P. I. 39	99.75
Motorcycle, Indian	62.35
Bicycle, Humber	33.34
Total	₱400.63

TABLE XV.—*Expenses and income of the Bureau of Agriculture during the year*

EXPENDITURES

Salaries	₱889,855.38
Wages	222,854.66
Traveling expenses of personnel	238,611.44
Freight, express and delivery service	18,950.17
Postal, telephone, telegraph and cable service	23,930.39
Illumination and power service	7,289.08
Contingent service	5,732.03
Rental of buildings and grounds	9,418.19
Consumption of supplies and materials	191,377.53
Printing and binding reports	....
Documents and publications	30,275.00
Cash contributions and gratuities	36,688.86
Maintenance and repair of equipments	23,466.89
Outlays (furniture and equipments)	20,980.51
Deterioration of supplies and sales	....
Stock	5,002.87
Extraordinary losses	8,304.60
Total expenditures	₱1,732,737.60

TABLE XV.—*Expenses and income of the Bureau of Agriculture during the year*—Continued.

INCOME

Income from rentals	₱1,127.50
Service income	135,537.49
Miscellaneous receipts	101,277.72
Total income	237,942.89
Net cost	1,494,794.89

OPERATION STATEMENT—SPECIAL APPROPRIATIONS
JANUARY 1 TO DECEMBER 31, 1921

EXPENDITURES

Purchase and resale of seeds	₱90,000.00
Immunized cattle insurance fund Act No. 2458	49,845.12
Construction of temporary buildings, sheds, fences, and pens, Act No. 2736	121.63
Construction of buildings, sheds, fences, coops, and pens, Act No. 2786	18,358.38
Construction of buildings, sheds, fences, and pens, Act No. 2898	7,498.33
Mutual insurance of work animals, Acts Nos. 2764 and 2903	47,604.80
Mutual insurance of work animals, Acts Nos. 2764 and 2903	469.01
Total expenditures	213,807.27

INCOME

Purchase and resale of seeds	₱87,712.44
Immunized cattle insurance fund, Act No. 2548	277.50
Mutual insurance of work animals, Acts Nos. 2764 and 2903 (premiums)	48,575.75
Mutual insurance of work animals, Acts Nos. 2764 and 2903 (membership fees)	10,129.30
Food productions campaign, Acts Nos. 2723 and 2850	953.54
Total income	147,648.53
Net cost	66,248.74

ACCOUNTING DIVISION

Auditing and accounting.—At the beginning of the year, the Accounting Division had 20 employees. Nine new men were appointed during the year. Six old and experienced employees left the service. One of the employees that resigned was the chief of the Auditing Section.

The Division is sub-divided into a Bookkeeping Section, Auditing Section, and Agricultural Colony Accounts Section. Each employee is assigned to a particular task but may be assigned different work at times for the good of the service.

As usual, during the early part of the year, the chief and assistant chief of the division devoted most of their time to the closing of the 1920 accounts.

The expenses and income of the Bureau were recorded under different classifications of expenses and income and functions of each division the same as in 1920.

The functional accounts during the year were increased from 166 to 411. The actual cost of each campaign carried on by each division was recorded by classifications of expense the same as in 1920.

Due to the remarkable increase in the activities of the Bureau as evidenced by the almost 200 per cent increase in the functional accounts, and the fact that most of its clerks were new and inexperienced, the monthly trial balance could not be submitted to the Bureau of Audits within the period required by a circular of the Insular Auditor. The project ledger system was then adopted in March, which made it possible to submit the trial balance within the required period.

Previous to August 1, 1921, practically all of our field employees were paid by special disbursing officers of the Bureau. But due to the delay in submitting their monthly disbursements to the Central Office, the system was discontinued. Payments were then made direct by the Central Office on warrants beginning August 1, 1921.

In May this office started a vigorous campaign for the collection of our accounts receivable. The coöperation of the Insular Auditor in assisting this office in this work made the campaign more effective. More than ₱94,000 was collected within six months from the time the campaign was started. The total amount collected from January 1, 1921, to May 31, 1921, was ₱22,402.35.

RECOMMENDATION

As the amount of work is steadily increasing it is important that means be made available to get, as well as to hold, experienced employees by allowing them better compensation for their services.

PROPERTY DIVISION

ACTIVITIES

(*a*) Requisitioning, receiving, issuing and shipping supplies, equipments, animals, serum, plants, seeds, etc.

(*b*) Attending to property store, records, and transactions.

The personnel of the Property Division was at the beginning of the year composed of 1 chief of the Division, 6 clerks, 2 chauffeurs, and 14 laborers. During the year the position of assistant chief of the Division which had been vacant for some

time was filled. Two new clerks and 3 laborers were also appointed. Later, however, owing to the required reduction of expenses for salaries and wages, 9 laborers were dropped.

The work of the whole division is divided into 6 sections, as follows: (1) Requisitions; (2) record of the responsibility of individual employees; (3) station property other than animals; (4) station property, animals only; (5) storeroom, shipping and receiving; and (6) truck transportation. The work of each section is performed by one clerk, except that of the storeroom to which 2 clerks and 5 laborers are assigned, and the trucking, which is done by the two chauffeurs and 3 laborers.

The principal work of the Property Division is the acquisition of supplies and equipment, furnishing the same to the different divisions, field employees and provincial stations of the Bureau, accounting for all such property and attending to shipments.

During the early part of the year physical inventories were taken to check property records, and the general annual inventory of property which was submitted to the Insular Auditor on February 15, 1921, made.

Below is a summary of the work performed by the Division during the year:

PROPERTY ACQUIRED DURING THE YEAR

Fixed assets	₱35,790.99
Supplies and materials (B–5)	143,081.63
Sales stock	58,184.88

ROUTINE WORK ATTENDED TO

Bureau of Supply requisitions	₱199
Bureau of Printing requisitions	58
Direct orders	360
Work orders	217
Property notifications	215
Shipping memoranda	1,869
Requests for supplies and issue slips	16,918
Memorandum-receipts	592
Invoice-receipts	143
Livestock-reports	261
Bills of Lading	1,577

SHIPMENTS MADE AND RECEIVED

	Number	Cases bundles, etc.	Cost
To the provinces	1,577	7,014	₱241,449.66
From the provinces	698	7,314	74,556.52
To foreign countries	18	51	6,362.66
From foreign countries	19	78	11,531.78
Total	2,312	14,457	333,900.62

VETERINARY DIVISION

ACTIVITIES

(*a*) Inspections, quarantine and immunization of animals imported from foreign and domestic ports.

(*b*) Coöperation with provincial and municipal officials in suppressing dangerous communicable animal diseases.

(*c*) Maintenance and operation of quarantine and immunizing stations.

(*d*) Meat-inspection in Manila and Sisiman. Coöperation with local authorities in municipal slaughterhouse system.

(*e*) Preparation and application in the field of anti-rinderpest serum and vaccine.

(*f*) Research: Investigation of the causes, prevention, and treatment of dangerous communicable animal diseases.

PERSONNEL

On December 31, 1920, there were (on the rolls) 31 veterinarians (of whom 25 were Filipinos and 6 Americans), 3 American livestock inspectors, 230 Filipino inspectors, 1 American clerk and 3 Filipino clerks.

On December 31, 1921, the force consisted of 38 veterinarians (of whom 32 were Filipinos and 6 Americans), 3 American livestock inspectors, 236 Filipino inspectors, 1 American clerk and 1 Filipino clerk. This constitutes an increase of 7 Filipino veterinarians and 6 Filipino livestock inspectors and a decrease of 1 Filipino clerk.

ADMINISTRATION

Importation from foreign ports.—There was a considerable increase in the importation of cattle, the number of carabaos remaining about the same as during the preceding year. The majority of the cattle were from French Indo-China and were brought in for slaughter. Eighteen cows were imported from Australia for dairy purposes and one Ayrshire bull for breeding purposes from the United States.

Inter-island shipments.—The number of cattle arriving in Manila from inter-island ports amounted to only 6,856 during the year, as against 11,350 in 1920. There were 906 carabaos received as compared with 2,448 in the previous year.

Inspections for which fees were charged.—During the year 156,956 animals of all kinds were inspected on arrival at the City of Manila, for which fees amounting to ₱20,964.00 were charged and collected. Of these animals 116,509 were hogs.

Post-mortem inspections in Manila Matadero.—There were 112,389 animals of all kinds inspected at the Manila Matadero

during the year, 847 being condemned and 111,542 passed for food. The number slaughtered includes 104,017 swine.

Post-mortem inspections in Pandacan Matadero.—During the year 23,327 cattle and 43 carabaos were slaughtered and inspected at this matadero. Of these 7 were condemned and 23,319 passed for food. This matadero is used for the slaughter of animals imported from Asiatic countries.

Post-mortem inspections in Sisiman Matadero.—During the year 728 cattle were slaughtered and inspected at this matadero, 11¼ of which were condemned and 728¾ were passed for food. This matadero is used for the detention and slaughter of cattle imported from that port of Australia infected with contagious bovine pleuro-pneumonia.

COMBATING OF ANIMAL DISEASES

Rinderpest.—There were 45,380 cases and 35,740 deaths from this disease recorded during the year. This is twice as many as the cases and deaths (22,442 cases and 16,911 deaths) reported in 1920. While the disease appeared in 35 different provinces its ravages were severest in the Visayan provinces, as over two-thirds of the cases and deaths occurred in the Provinces of Antique, Bohol, Capiz, Cebu, Iloilo, and Occidental Negros. Outside the Visayan region the Provinces of Bulacan and Masbate were the worst infected. Sporadic outbreaks of limited extent occurred in the following provinces: Abra, Albay, Bataan, Batangas, Cagayan, Camarines Norte, Camarines Sur, Cavite, Ilocos Norte, Ilocos Sur, Isabela, Laguna, Lanao, Leyte, Manila City, Mountain, Nueva Ecija, Nueva Vizcaya, Oriental Negros, Pampanga, Pangasinan, Rizal, Samar, Surigao, Tarlac, Tayabas, and Zambales.

The following table shows the number of rinderpest cases and deaths by three months periods during 1921:

Rinderpest cases and death by quarters

	New cases	Deaths
First quarter	9,134	7,000
Second quarter	11,450	9,088
Third quarter	13,864	11,138
Fourth quarter	10,932	8,514
Total	45,380	35,740

During the year 357 new outbreaks of rinderpest were reported, counting each case where a municipality was taken up as infected or reinfected as a separate outbreak.

The political entity known as the Province of Masbate had two distinct invasions of rinderpest during the past year. On the 26th of January, 1921, Mr. Fidel Sendagorta, who owns a

Isolation corrals for infested animals. Ilagan, Isabela

(a) Quarantine force composed of Bureau of Agriculture inspectors and Constabulary soldiers.

(b) An isolation corral for infested animals. Ilagan, Isabela.

herd of more than 2,000 heads of cattle on the island of Burias, received a rush telegram from the man in charge of the ranch that several animals were infected with a contagious disease and that many deaths were occurring daily. From the description that he gave of the symptoms, we quickly concluded that the disease was rinderpest. Mr. Sendagorta was anxious to save as much of the herd as possible, regardless of expense. Accordingly, a large quantity of serum was gotten together that very day and that same night two veterinarians embarked with Mr. Sendagorta on a steamer under contract with him to make a special call at the Island of Burias. Upon arrival at this place, the veterinarians immediately diagnosed the disease as rinderpest and corrals and chutes were at once constructed preparatory to the inoculation of the animals with serum. Mr. Sendagorta's animals fortunately were divided into two separate herds and only one of these was infected. The injection of the infected herd was begun at once and all the animals in it, both sick and well, were given large doses of anti-rinderpest serum. Mr. Sendagorta himself employed several additional men and a quarantine line was established between the two herds. The infected herd had a total of 504 cases with 330 deaths. If it had not been for the immediate use of anti-rinderpest serum in large doses, there is no doubt but that the greater part of that herd would have been lost. The quarantine was maintained so efficiently that his free herd never became infected, and hence, were not injected with anti-rinderpest serum.

The cause of this outbreak of rinderpest was carefully investigated by the veterinarians, as the Island of Burias had not been infected with this disease since the outbreak of 1900 and 1901. It was discovered that animals from the Province of Sorsogon had been clandestinely introduced into the sourthern part of the island during the months of October and November, and that shortly afterwards animals in that section commenced dying and the disease worked northward until the herd of Mr. Sendagorta became infected. The investigation of our veterinarians also showed that animals belonging to the councilman of the district of Claveria had died during the previous month. These facts were all presented to the Provincial Board of Masbate with the request that they take immediate action and proceed against the responsible officials. Up to date, this office has not been informed as to the action taken by them in the matter. The campaign conducted on the Island of Burias by the representatives of this office, with the splendid assistance given by Mr. Sendagorta, confined the disease to the southern portion of the island, it never spreading any further north than his ranch.

In the first days of July, this office received a report that cattle and carabaos were dying in the municipality of Aroroy on the Island of Masbate. Veterinarians were immediately dispatched to investigate the reports, and found the disease to be rinderpest in a virulent form, and that it had already spread over the major portion of the municipality of Aroroy. The diseases had obtained such a good foothold, was spreading rapidly and was so virulent that it was threatening the herds of the entire island. This office quickly gathered together a large force of veterinarians and live-stock inspectors and dispatched them to the Island of Masbate. The coöperation of the Bureau of Constabulary was also secured and 250 Constabulary soldiers were detailed for quarantine duty. It was impossible to do anything toward the isolation of the infected herds as the owners allowed them to scatter immediately upon the appearance of the disease. It was therefore necessary to establish quarantine dead lines on the outside of the infected regions in an endeavor to hold the disease from spreading beyond the infected area. A base line was established across the island from Lumbang to Milagros to act as the final line of defense for the southern portion of the island, which is the main cattle raising section. Another line was thrown around the infected area beyond the then known infection. In the third week of July, as the veterinarians were extending the area of operations, rinderpest was discovered in two barrios of the municipality of Milagros, distant 20 kilometers from the nearest infection in Aroroy. It is evident that some individual had removed some animals from the infected region before the establishment of the quarantine line. This necessitated the reforming of the quarantine line around the infected area and also the establishment of another line across the Pulanduta peninsula from the Gulf of Asid to Mandaon. These lines have held exceptionally well and the rinderpest outbreak on the Island of Masbate is now rapidly abating. Considerable difficulty has been encountered on account of the spread of rinderpest by infected deer and wild hogs. Many cattle from the infected herds that had been turned loose went to the mountains and were the cause of conveying the disease to the wild animals.

A campaign of vaccination is also being carried on, starting first with the animals adjoining the Lumbang-Milagros quarantine line and then working toward the infected area. This campaign has been rendered very difficult on account of the exceedingly poor transportation facilities and the absence of

good roads and bridges on the Island of Masbate, and also due to the fact that the people have not always given the assistance that was required of them. In spite of all these handicaps, the work has proceeded very satisfactorily and up to date has given good results.

From the time of introduction of the rinderpest into the Island of Masbate up to December 31, there were a total of 3,372 cases followed by 2,914 deaths.

For several years we have been cautioning the people of Masbate to admit no animals from other provinces unless accompanied by a certificate issued by authority of this office to the effect that they have been immunized against rinderpest by simultaneous inoculation. Particular emphasis has been laid on the fact that the re-introduction of animals that had been taken to other provinces for sale would eventually lead to the infection of their island with rinderpest. The officials have on several occasions been instructed to impress upon the minds of the people that when animals were taken to other provinces for sale they must all be disposed of and not a single head returned to Masbate. We have reliable information to the effect that in the month of June, a certain individual in the municipality of Aroroy took some carabaos in a sailing vessel to the Province of Occidental Negros for sale to the sugar people. It further appears that he did not sell all of the carabaos as he could not obtain the price that he wanted for each and every head. After having been in Negros for some time, he quietly reëmbarked the unsold animals and went back to the Island of Masbate. The Province of Occidental Negros was infected with rinderpest at the time and the animals that he returned to Masbate sickened shortly afterwards, and thus introduced the disease into that province.

During the past year there have been several requests from provincial governors for the permanent assignment of veterinarians to their respective provinces. It has been impossible to comply with these requests owing to the fact that the veterinary personnel is so limited that there are not enough veterinarians to attend to all of the infected provinces. It is and has been for years the hope of this division that eventually it would have a veterinary personnel large enough to enable it to assign a veterinarian permanently to each province and 2 veterinarians to some of the larger ones. This would mean a field force of 55 veterinarians, but this will be necessary if it is the desire of the Government to be able to establish effective control of dangerous communicable diseases in all parts of the Archipelago.

The lack of sufficient veterinarians is one of the reasons why the best coöperation of live-stock owners cannot always be secured, as they become discouraged because of the lack of technical advisers.

The turning over of the control of dangerous and communicable animal diseases to the provincial officials has not worked out very satisfactorily in practice. With few exceptions, the provincial governors and their representatives, the municipal presidents, are not taking the initiative that they should in enforcing the preventive measures for the control of rinderpest. Whenever they can, they try to leave it all to the representatives of the Bureau of Agriculture and only show some activity where political motives impel them to do so. The glaring fact stands out that at no time, since the control of contagious animal diseases was turned over to the local officials, has a single province made a regular yearly appropriation to take care of the animal disease control work. They have frequently requested the assignment of veterinarians and live-stock inspectors of the Bureau of Agriculture to their respective provinces, but have made no move toward employing veterinarians of their own.

It is, however, becoming more apparent that the people are gradually becoming disillusionized. For the past two years, several representatives in the Philippine Legislature have been discussing and making tentative plans to return the control of dangerous and communicable animal diseases to the Director of Agriculture where it properly belongs. This year they have gotten along with the matter far enough to present a bill to this effect in the Philippine Legislature. It is hard to tell whether it will become a law at this session or not, but one thing is fairly certain—that the people are beginning to see the light and the change will be made at least within another year or two.

Anti-rinderpest serum.—Anti-rinderpest serum has been employed in the field as an aid in the control of rinderpest in those places where the live-stock owners have been willing to pay for it. The Bureau of Agriculture, several years ago, discontinued the policy of the extensive employment of anti-rinderpest serum free of charge. This is due to the fact that the length of the period of immunity conferred is so short that it is not commensurate with the expense involved in the production and use of the serum, particularly so, when it is difficult to enforce adequate quarantines in infected areas. Serum is now used principally in those places where cases of rinderpest have recently appeared or in which infection is imminent. This ordinarily results in the exposure of the animals to the disease after having

received large doses of serum and before it can be eliminated from the body of the animal; by this procedure many animals pass through a modified attack of rinderpest and thus acquire a more lasting immunity. When the serum is employed on animals which are not close to infection, they are liable to contract rinderpest after the elimination of the serum from the body which is usually from 10 to 15 days. The total amount of serum produced by the Bureau of Agriculture during the past year was 4,360 liters.

Immunization.—During the past year, immunizing operations have been carried on at Candaba, Pampanga; Lipa, Batangas; Iloilo, Iloilo, and the Pandacan Quarantine Station, Manila. A total of 19,127 animals were immunized against rinderpest by simultaneous inoculation. The mortality resulting from immunization was a trifle less than 2 per cent.

The benefits resulting from the immunization of cattle and carabaos are well demonstrated in the Province of Pampanga where this work has been carried on since 1916, through the splendid coöperation of Governor Ventura. In previous years that province was always a hot-bed of rinderpest and the losses suffered were considerable. In those districts where a large percentage of the animals have been immunized, rinderpest is non-existent and is no longer a serious factor. During the past year, there have been some minor outbreaks of rinderpest, but they occurred in areas where immunizing operations had not been carried on. The people have now become thoroughly convinced of the advantages derived from immunization, and the opposition against it is now negligible. The people of Occidental Negros have also observed its benefits. They are the heaviest purchasers of the carabaos imported from French Indo-China, which are all immunized against rinderpest before being released from quarantine. During the past year, there has been a severe outbreak of rinderpest in that province among the native carabaos, but none of the immunized Indo-Chinese carabaos contracted the disease, even though they were in close contact with the infection. Requests have been made by people in Occidental Negros for the establishment of two immunizing stations in that province, but unfortunately, this office has not been able to acceed to these requests, owing the lack of funds at our disposal for this work. A proposed bill has been presented to the Philippine Legislature requesting an appropriation of ₱150,000 for the extension of immunizing operations.

Each of the immunizing stations now regularly shows a deficit. Act No. 2548 provides for the payment of a fee of ₱3

for each animal immunized. This fee is to cover the expense of construction and maintenance of the stations and the payment of 75 per cent of the value of the animals that die during the process. At the time this Act was approved by the Legislature, the prices of animals were considerably lower than they are now, as well as the cost of construction and maintenance of the stations. This office has recommended that the fee be raised to ₱5 per head, which will not entail any undue hardship on the owners of animals. If it should not be deemed expedient to increase the fee, then the Government will have to be prepared to meet the deficits as they occur at the various stations.

Other diseases.—The following diseases are prevalent in the Islands and take their toll of deaths year after year though they have caused no general alarm as the losses are relatively small compared with the losses from rinderpest. No accurate records have been kept of the cases and deaths from these diseases, owing to the lack of personnel, and for the same reason no campaigns have been undertaken towards eradicating them. Rinderpest has taken all the energy and time of the small force at the command of this division.

Anthrax.—During the year no cases of this disease have come to the attention of this office. The lack of personnel may account for this. Observations of previous years have shown that sporadic cases of this disease do occur from time to time in various regions of the Islands notably along the shore of Laguna de Bay, and in certain sections of northern Mindanao.

Hemorrhagic septicaemia.—Small outbreaks were reported during the year in the Provinces of Mountain, Isabela, Ilocos Sur, and Rizal. The losses caused by this disease were slight.

Contagious bovine pleuro-pneumonia.—During the year cases of this disease were found among the Australian cattle imported for slaughter at the Sisiman Matadero. The quarantine station of Sisiman is fairly well issolated to insure against any possibility of the disease spreading out into the provinces. The theory that this disease is not highly contagious in the tropics seems to be well born out by the observations carried out at Sisiman extending over a period of many years. Native work carabaos at the station in continuous contact with infected Australian cattle have failed to contract the disease.

Surra.—During the year this disease was reported in Burias Island and along the northern coast of Cagayan Province. It is prevalent in all provinces but is not usually reported by the local authorities unless it causes considerable mortality. The losses occasioned by this disease are large enough to affect adversely

the proper development of the horse industry in the Philippines. Effective methods of controlling this disease have not yet been discovered.

Glanders.—Isolated cases of this disease have been reported from time to time throughout the Islands but no serious outbreaks have occurred this year.

Hog cholera.—No accurate records of the total losses due to this disease have been kept owing to the lack of means, but it is known to have prevailed throughout the provinces in a mild form. The research on the development of a vaccine for hog cholera was kept up throughout the year, and the results obtained so far are very encouraging.

Contagious abortion.—This disease has never been known to exist in the Philippine Islands. For this reason strict measures were adopted when a few cases of suspected contagious abortion appeared among a dairy herds of Indian cows in the City of Manila. It was not possible, however, to arrive at a definite diagnosis of the suspected cases as they had all died before diagnosis could be completed. Fortunately, no more suspect cases have appeared for the past eight months.

This disease is widely prevalent in India, and, therefore, great care should be exercised when importing breeding animals from that country.

Tuberculosis.—This disease has not yet been found among the native cattle and carabaos. The few cases encountered this year were among the cattle imported for slaughter from Australia and French Indo-China. It was also found in a slight degree among hogs slaughtered at the Azcarraga Matadero.

Foot and mouth disease.—Mild but protracted outbreaks of this disease were reported in the Provinces of Ambos Camarines, Sorsogon, Masbate, and Surigao. The losses caused by this disease were small, and it was noticed that the virulence is on the decline.

ILOILO QUARANTINE STATION

During the year but 2,536 carabaos and cattle arrived at this port from French Indo-China, and Pnom-Pehn as compared with 8,500 head imported in the previous year. This was due to the business depression prevailing throughout the year.

SISIMAN MATADERO

Operations were resumed at this slaughterhouse after a lapse of five years, with the importation of two shipments of Australian cattle on October 31 and November 29, consisting of 309 and 430 heads, respectively. All these cattle were slaughtered

before Christmas, and the importers stopped importation to resume it next year. The slaughterhouse, sheds, and fences had to be repaired by the importers themselves as the Bureau had no funds with which to undertake this work. No repairs had been made at this station since its establishment, excepting the repairs made to the superintendents' house and the construction of a new pier.

SAN LAZARO IMMUNIZING STATION

The building and sheds in this station have been transferred to the College of Medicine and Surgery of the University of the Philippines in exchange for the small concrete building belonging to that college located on the grounds of the Pandacan Quarantine Station.

VETERINARY RESEARCH LABORATORY

During the past year, we have installed at the laboratory 2 Sharples supercentrifuges of the small laboratory type with a Rix air compressor and a Fairbanks-Morse crude oil engine for operating the compressor and centrifuges; also a large electrically heated water bath. This new equipment plus the refrigerating plant and the Matthews tissue mill installed during 1920, make it possible to produce a larger quantity of anti-rinderpest vaccine. The main point at the present time, is to secure sufficient material from which to make the vaccine. The laboratory is still in need of some type of ball mill to get the vaccine in complete suspension before it is used. At the present time, mortars are used to work it up into suspension, which, to a certain extent, may subject it to external contamination. With the proper type of ball mill, the changes for external contamination would, to a great extent, be eliminated.

By aid of the Sharples contrifuge, we are able to produce vaccine in a concentrated pasty form. In this condition, it retains its potency for a much longer time than when in liquid suspension. This pasty vaccine has given good protection to highly susceptible animals, even after being kept for as long as 6 months.

The vaccine is sent to the provinces in Ferrostat Thermos bottles, thus keeping it at a low temperature up to the time of use. During the past year, 30,000 animals have been vaccinated in various provinces with highly satisfactory results. Numerous outbreaks of rinderpest have been smothered out and the owners of animals are well satisfied with the benefits they have derived from it. We have vaccinated with good results Herford cattle imported from the United States and dairy cows from Australia.

Several of these cows were giving milk while undergoing vaccination, and little or no change in the milk supply could be noticed. Also several of the cows gave birth to normal healthy calves during the period they were being immunized by the vaccine method.

The research laboratory is so located that we are in intimate connection with the quarantine station and slaughterhouse, where imported animals are quarantined and even slaughtered. During the past year, we have obtained material for vaccine from 353 of these animals, most of which were Indo-Chinese and Hongkong bulls. This has effected a considerable saving to the Government in the cost of vaccine production.

A building located on the grounds of the Pandacan Quarantine Station and formerly belonging to the College of Medicine and Surgery of the University of the Philippines was transferred to this office a few months ago. This building has been remodeled to some extent and is being used for work on hog cholera. Results have already been obtained showing that vaccine against hog cholera can be produced. During the coming year, we hope to have the hog cholera vaccine on as good a basis as the rinderpest vaccine at the present time.

All the diagnostic work on rabies for the Bureau of Health has been performed at the Veterinary Research Laboratory during the past year.

RECOMMENDATIONS

In the last annual report, it was recommended that the Legislature be asked to amend Act No. 2545, so as to increase the immunizing fee from ₱3 to ₱5 per head. This recommendation is again reiterated for the reasons given under the paragraph on immunization.

Section 1 of the original draft of the Act providing for the immunization of cattle and carabaos in the Philippine Islands reads as follows:

> SECTION 1. Whenever rinderpest infection exists or whenever a request has been made by resolution of the provincial board of any province for the immunization of cattle in said province, the Director of Agriculture is hereby authorized to require that all cattle and carabaos within, exported from or imported into, an infected area shall be immunized against rinderpest by simultaneous inoculation at such time and place as he may deem necessary to prevent the spread of rinderpest within the Philippine Islands.

Section 1 of this Act No. 2548 as passed by the Legislature, reads as follows:

> SECTION 1. Whenever rinderpest infection exists in any province and the provincial board has, by resolution, determined the immunization of

cattle in said province, the Director of Agriculture is hereby authorized to require that all cattle and carabaos within, imported into, or exported from an infected area shall be immunized against rinderpest by simultaneous inoculation at such time and place as the provincial board, upon agreement with the Director of Agriculture, may deem necessary, *but not outside* of the limits of the municipality in which the cattle are found, in order to prevent the spread of said disease within the Philippine Islands.

This section of the law is not very satisfactory as it leaves the Director of Agriculture with too little authority and gives too much chance for the entrance of political influence. When rinderpest is severe in a district where immunization is undertaken, it is usually fairly easy to obtain enough animals to operate a station at its capacity. However, when with the progress of immunization in that locality rinderpest has been reduced to a minimum, it becomes very difficult to obtain sufficient animals. This is due to the fact that with the decline of rinderpest in that locality the people lose their fear of the outbreak, are more inclined to take a chance with non-immunized animals and are averse to going to the trouble of bringing in their animals and keeping them at the station during the time required for immunization. On this account, we have frequently been compelled to close up stations before all the animals in the locality had been immunized. This in a way defeats the object of the immunization, as it leaves a certain number of non-immunized animals which may later become infected and spread the rinderpest to adjoining regions where the animals have not been immunized. Section 1 of Act No. 2548 should therefore be amended to conform with that section as proposed in the original draft.

PLANT INDUSTRY DIVISION

ADMINISTRATION

ACTIVITIES.—*Agronomy and horticulture*

(*a*) Plant breeding.
(*b*) Seed and plant introduction.
(*c*) Vegetative propagative experiments.
(*d*) Cultural experiments.
(*e*) Laboratory experiments.
(*f*) Fertilizer experiments.
(*g*) Crop rotation experiments.
(*h*) Experiments on preservation and storage of seeds and fruits.
(*i*) Seed and plant distribution.
(*j*) Agricultural exploration.
(*k*) Agricultural intelligence service.

Organization.—As last year, the Division was divided into two main sections, namely, the Agronomy and Horticulture sections.

Personnel.—At the close of the year there were 34 employees in the Division, including 4 clerks. One of the employees is at present abroad specializing in sugar technology. There was one new appointee, two reinstated, one transferred from the Division to Momungan Agricultural Colony, and one resigned.

Labor.—Due to the retrenchment policy of the Government, the labor force at every station was considerably reduced the latter part of the year.

Permanent improvements.—(*a*) Alabang Central Rice Station. One building costing ₱700 was constructed for the use of laborers.

(*b*) *Lamao Experiment Station.*—Three cottages for laborers and one implement shed were built during the year.

A special allotment of ₱900 from Act No. 2898 was made available for the repairs of the station fence. A good portion of the fence was put in perfect condition.

EXPERIMENT STATION WORK

There are altogether 12 experimental and propagation stations under the supervision of the Plant Industry Division.

SINGALONG PROPAGATION AND TESTING STATION

This station serves as the center of distribution of plant and seed materials going to and coming from the provinces and other countries. There are, besides, many fruit trees and several forage crops for propagation and distribution purposes grown here. Seed testing and various vegetative propagation experiments are also conducted at this station.

Plant propagation.—Ten thousand seedlings were transplanted into the regular nursery rows for stocks. The most of these are now ready for grafting and budding.

Among them are 3,048 mango seedlings that were successfully grafted and budded with selected mango scions. Many of them are now ready for distribution. Mango budsticks of 10 varieties were received from the United States Department of Agriculture, and they were grafted into our native mango stocks but only four have succeeded. These will be incorporated in our collection at Lamao. The budding of other fruit trees was continued as usual in connection with the plant propagation for distribution.

Miscellaneous horticulture.—Experiments on grafting the lanzon have succeeded since late last year, but due to the shortage of lanzon stocks there were not many grafted. However, there are now 1,794 seedlings in the plant shed which could be grafted during the middle part of 1922.

Very encouraging results were obtained in budding the Rimas, using the Camansi as the stock plant. Grafting has not given any result, but this will be tried again.

Forage crops.—Small plots of Guinea grass, Napier grass, and Uba cane have been cultivated for distribution purposes.

Germination test.—A germination test was given to every newly received lot of seed before these were being distributed. There were 2,011 samples tested consisting of 857 varieties.

ALABANG CENTRAL RICE BREEDING STATION

Rice—(*a*) *General variety test.*—In this work 232 varieties, mostly native, were used. Two varieties were from Borneo, 1 from Formosa, 9 from Saigon, 6 from Siam, and 1 from the United States. Classified under general characteristics there are 134 varieties which are white, non-glutinous, and non-bearded; 7 which are red, non-glutinous, and non-bearded; 13 which are white, glutinous, and bearded; 70 which are white, non-glutinous, and bearded; 7 which are red, glutinous, and non-bearded; and 1 red, glutinous, bearded.

Practically all the native varieties gave good yields this year. The failure of a few to produce even a normal yield was due partly to the presence of abortive panicles containing a high per cent of light grains. It is interesting to note that the Indo-Chinese varieties and two varieties from Borneo are quite neutral to Alabang conditions.

(*b*) *Head-to-the-row test.*—Seven varieties were grown in this test. Each variety was represented by seeds obtained from several selected stock plants. The seeds were sown in seedbeds on June 9 and the seedlings were planted in permanent plots a month later. It was observed during the growth of the plants that the check rows were inferior to the selected strains in many respects, as was expected.

(*c*) *Selection work with bearded rice.*—Many of the bearded varieties are very good yielders. Bearded varieties are as a class vigorous and strong and their grains are attached more tenaciously to the spikelets than those of the non-bearded varieties. These desirable characteristics have led the Bureau of Agriculture to seek means of eliminating or at least reducing the objectionable awns from the good yielding varieties.

It is believed that this can be done simply by selecting panicles containing beardless grains and by planting only those grains. The panicles from which the seeds had been taken for this work were selected from among numerous bearded varieties last year. The percentages of non-bearded grains according to this first set of trials range from zero to 14 per cent, although as high as 22.1 per cent has been recorded from individual panicles.

(*d*) *Hybridization.*—The first step in the rice hybridization work was taken last year at Alabang when two varieties, Apostol and Cruz, were crossed for desirable, compensating characters. Three of the zygotes germinated. The seeds were first germinated in a plain agar medium in test-tubes but before the plantlets had consumed their food stored in the grains they were transplanted to a sterilized soil. When the seedlings had grown sufficiently hard for handling they were finally transplanted to petroleum cans containing typical Alabang paddy soil. So far there is nothing certain about the plants being true hybrids, though one appears to be a hybrid. This particular plant, besides being more vigorous than both parental plants in the check culture, presents characteristics intermediate between the Apostol and Cruz plants. The two other plants, though comparatively larger than either one of the parents, bear a strong resemblance to the Apostol.

Other crosses have been made with the following varieties:

Apostol × Shinriki.
Cruz × Señora II.
Ohoy II × Caviteña I.
Tarbayanon I × Señora II.
Señora II × Saan a Pinili.

(*e*) *Acclimatization of some foreign varieties.*—Two cultures were made during the year—one in the field and the other in cans under control. Trials were made also during the regular rainy season of varieties from other countries as follows:

VARIETIES

From Borneo	10
From Japan	5
From United States	11
From Java	9
From Persia	5
From Madagascar	4
From Indo-China	1

From these experiments it may be concluded that the planting of the medium and late varieties during the dry season serve only to delay maturity to the detriment of the crops.

(*f*) *Viability test.*—This work provides for the monthly tests of germination of the Apostol, Cruz, Roxas, and Conner palay. Samples were extracted from the different portions of the sack contents and out of the mixture were counted exactly 200 grains, not including defective ones. They were then set to germinate by the ragdoll method. The test was started in January 1921 and will be continued until zero per cent is obtained. The average percentages recorded for the four varieties showed that rice seeds three months after harvest (November harvest) have a vitality of something like 95 per cent but that this vitality increases until it reaches its maximum in June, and from that time on gradually falls. This fact needs further proof, however.

(*g*) *Dry season crops.*—This experiment to find varieties suitable for planting during the dry months was started three years ago, but never was so great a number of varieties included in the work as this year.

It was noted with surprise that Binicol, Dinagat, Kinampupoy and Mangasa, the established dry season (palagad) rices, gave unsatisfactory yields. The Sanglay and Sipot proved much better yielders in spite of their being new, so to speak, to dry season conditions. Sinaryaya, Magsangle, and Kaawa gave good crops. It would seem, therefore, that some of the early maturing rices now under the variety test might upon trial qualify as dry season croppers.

(*h*) *Weed control experiment.*—Two series of paddies were selected, and planted to rice seedlings at the same time. Just after plantation the first series were kept submerged in water to a depth of 15 centimeters. This depth was gradually increased as the plants grew taller. Forty days after transplanting the water supply was cut to a minimum. Meanwhile the second series of paddy were given water to a depth varying from surface level to 5 centimeters.

In the paddies of the first group where the water was kept to a good depth, comparatively very few weeds developed and these seemed to be of a few species only (*Cyperus* species and *Ipomeea raptans* for the most part). But in the second group of paddies numerous species appeared in great number. Here the ground had to be weeded four times. In the paddies of the first group one weeding was sufficient.

(*i*) *Fertilizer experiment with rice.*—Two commercial mixtures of "rice fertilizer" were applied—their formulas are known. With a view to placing the plants under control petroleum cans with soil typical of the station rice land taken from one of the paddies were used. The contamination which

might result from the rusting of the containers was prevented by coating the inside walls of the cans with paraffin.

With the No. 1 three different rates of application were used: 700, 500, and 300 kilos per hectare. In one set the application was made before planting the seedlings; in the other set the fertilizer was applied in two equal installments, one application before planting and another 30 days afterwards. Control plants were maintained.

All the plants used in this experiment were the products of one mother plant (Cruz) and were a pure line. The results were the same for plants receiving the fertilizer at once or in two separate applications.

TABLE XVI

Application per hectare	Number of plants	Average number of culms	Average height	Average weight of straw	Average weight of panicles	Average number of grains per plant
Kilos.			*cm.*	*Grams.*	*Grams.*	
700	6	7.7	88.6	66.2	26.0	888.5
500	6	8.1	85.9	64.0	26.3	930.0
300	6	7.8	84.4	59.8	24.1	841.5
None	6	5.7	87.0	32.3	17.1	644.0

The same method of procedure was followed with the No. 2 fertilizer, only that additional cultures were given fertilizer at the rates of 100 and 1,000 kilos per hectare, respectively.

Results:

TABLE XVII

Application per hectare	Number of plants	Average number of culms	Average height of plants	Average weight of straw	Average weight panicles	Average number of grains per plant
Kilos.			*Centimeters.*	*Grams.*	*Grams.*	
1,000	4	8	91.1	50.0	22.0	799.3
700	4	6	93.6	51.5	23.0	731.5
500	4	7	84.6	50.0	23.3	744.2
300	4	8	98.5	58.0	25.0	871.5
100	4	6	85.6	44.0	18.7	663.0
None	4	5	96.9	37.5	19.0	637.0

Where 300 kilograms of the No. 1 fertilizer per hectare were applied, the production was increased 30.7 per cent, and an additional amount of 200 kilos will further increase the yield by 10.5 per cent. But by increasing the rate to 700 kilos per hectare, a smaller crop was obtained. The effects of the No. 2 on the rice plant were less marked. The increase obtained in grain through the application of the No. 2 fertilizer at the rate of 100 kilos per hectare was imperceptible, but a gain equivalent

to 29.9 per cent was realized where the rate was 300 kilos per hectare. At the applications made at greater rates the increase was less.

By actual measurements it was found that the No. 1 fertilizer accelerated the growth of the plants during the first four weeks after the application. But with unfertilized plants the maximum rates of growth commenced after the seventh week of growth.

(*j*) *Seed propagation.*—It was decided to make a saving in the raising of crops for seed purposes by introducing the so-called "casama system" or having tenants work the land for a certain share of the crop. Under this system the tenant works the land, attends to the planting of the crop, takes care of this, and pays one-half of the expenses.

(*k*) *Planting rice by a drill planter.*—The drilling of palay by a drill planter was for the first time tried at Alabang on a piece of ground which had been well prepared. One important feature of this grain drill is that it can be pulled by two bullocks. The delivery tubes are set about 15 centimeters far apart. The rate of seeding is regulated by openning or closing the apertures leading to the tubes at the base of the seed box. The crop produced was about 30 cavans per hectare of Apostol rice. The land was not irrigated. It is believed that by widening the space between the rows, that is, by blinding every other delivery tube, a stand which will allow plants to tiller better will be secured.

(*l*) *Duty of water used in irrigation.*—This experiment is in its second year. The scheme of planting last year was followed with the slight modification of having included in the test extra early varieties, maturing in 118 to 130 days, instead of the 140-day rice employed last year in the first series. The preparation of the field and the methods of planting were the same as for the variety test.

The average weekly water requirements for the preparation of one hectare of paddy land were found to be .682 second-liter in a five-week period, or an equivalent total of 2,162,368 liters of water.

The water required for the seedbed preparation in one week's time was .612 second-liter, amounting to 370,138 liters. The area of the bed was 333 square meters.

During submergence an average flow equivalent to 1.519 second-liters of water was all that was necessary to mature 130-day rice on one hectare in a 12-week period; the 180-day rice would need in 18 weeks 1.465 second-liters; and the 200-day rice, 1,283 second-liters in 22 weeks.

The amount of water for submergence varies inversely with the growing period of the crop, in conformity, it seems, with its physiological needs. This also can be accounted for by the fact that the amount of rainfall decreases with the advance of the rice season, generally speaking.

A résumé of the results is given in the table, together with the data obtained from last year's experiment. It shows that more water was used this year.

TABLE XVIII

Classified period	140-day rice		180-day rice		200-day rice	
	1920	1921	1920	1921	1920	1921
	Sec.-lits.	*Sec.-lits.*	*Sec.-lits.*	*Sec.-lits.*	*Sec.-lits.*	*Sec.-lits.*
Field preparation to harvest	1.285	1.467	1.440	1.441	1.119	1.311
Seedbed preparation to harvest	1.242	1.566	1.124	1.516	1.107	1.364
Seeding to harvest	1.239	1.622	1.114	1.553	1.098	1.392
Transplanting to harvest	1.312	1.519	1.146	1.465	1.127	1.283

In 1920 the seed bed was prepared three weeks ahead of the paddy field while in 1921 the field was worked two weeks prior to the seedbed. This fact should be borne in mind in interpreting the results of the two experiments.

Sugar cane—Propagation work.—At the beginning of the year there were at the station the following varieties of sugar cane growing from plant canes:

1. Cebu Purple.
2. A white (unidentified) cane.
3. Java–247.
4. Lahaina.
5. Louisiana Striped.
6. Badila.
7. New Guinea–24.
8. Hawaii No. 16.
9. Hawaii No. 20.
10. Hawaii No. 27.
11. Hawaii No. 69.
12. Hawaii No. 109.
13. Hawaii No. 227.
14. Hawaii No. 309.

Hawaii–109 was found badly affected with an insect pest and diseases and the whole plot was dug up early in the year. The New Guinea–24 is a less important variety. The Negros Purple was grown from the few cuttings of the cane received from La Carlota, Occidental Negros, January 23. A bundle of Lahaina cuttings was added to the station stock this year.

There was a time when a scarcity of cuttings was experienced due to the accidental burning of all the plots of cane varieties in April from fire coming across a dry creek in a field belonging to the Bureau of Science. Only the Cebu Purple plot escaped injury. After cultivating the plots a ratoon crop was raised from the stubbles.

Seeds of the varieties Hawaii–20, H–27, H–69, H–109, H–309, Java–247, Louisiana Striped, Badila and an unidentified white cane were planted in December, 1920 at Alabang, but of these only H–20 and H–27, germinated. Their seedlings were potted in bamboo tubes on January 24, 1921 and on May 26 were set out in the field. A wide variation was noticed among the plants, and of the variety H–20, which is a tall slender cane, a few stout individuals appeared.

Recently further trials have been made to grow seeds of the Badila and Louisiana Striped, but only the latter succeeded in sprouting.

Forage crops.—There is not much work done at Alabang in connection with the forage crops beyond the propagating of the Uba cane, Guinea grass, Napier grass and barit, and of eight varieties of forage cane seedlings introduced in this station from the College of Agriculture, the early part of the year.

Miscellaneous agronomy—Adlay.—A small plot, 62.20 square meters in size, was planted to adlay in June, 1921. The land was prepared and planted as for corn. When fruiting time came two varieties (or forms) could be distinguished, which may be named provisionally, after the color of grains, as the white and the brown adlay. White adlay has a yellowish green stalk and light–buff grains. The brown adlay, on the other hand, has green internodes, with pink stria. The grain in its immature state is pink to violet but turns olive upon maturity.

The crop has shown a remarkable resistance to the weeds often met with in cane fields, like the coarse Aguiñgay grass (Rottboellia exaltata) and others.

Ragi.—Early this year a small quantity of seed was harvested from a patch on the sloping land in front of the serum laboratory building. The grain does not seem to be acclimated in Alabang.

LAMAO EXPERIMENT STATION

Citrus fruits—Orchard investigation.—Several vacant hills in the different orchards were replanted, and six plants each of mandarin and pomelo were also planted along the bank of the swamp in the station with the object of determining the adaptability of citrus to salt water. Pruning, eradication of diseases, cultivation and the planting of cover crops were continued as usual. There are under culture 17 different species, 212 hybrids and several other unidentified citruses. The 17 species of citrus include 237 different varieties, as follows: 23 *Citrus aurantifolia*, 11 *C. aurantium*, 14 *C. excelsa*, 12 *C. hystrix*, 9 *C. limonia*, 2

C. longispina, 3 *C. macrophylia*, 47 *C. maxima*, 9 *C. medica*. 1 *C. miaray*, 5 *C. mitis*, 4 *C. micrantha*, 30 *C. nobilis*, 48 *C. sinensis*, 4 *C. southwickii*, 14 *C. webberii*, and 1 *C. japonica*.

During the year, 21 varieties of sweet oranges (C. *sinensis*), 4 grape-fruits and 3 pomelos (C. *maxima*) were studied to determine which were best. As a result of this comparative test it was found that the 3,886 Duroi, 1,636 Washington Navel, 2,689 Enterprise, 4,128 Magnum Bonum, 1,260 Excelsior and 1,639 Ruby were the varieties of sweet oranges most worthy of further propagation and dissemination. The Cuyo and Jaffa sweet oranges can be ranked with the above varieties in quality and flavor.

The pomelos are rather shy bearers under Lamao conditions, while the grape-fruits are bearing good crops. However, among the latter group, only the Triumph variety has shown sufficient merit to justify wider culture.

The trees in the citrus orchards at this station were budded on different stocks. As most of the trees in fields A and B have attained maturity, an attempt has been made to correlate the adaptability of the different varieties of citrus on the different stocks. The results will be published in a separate paper.

Mango—Variety test and orchard investigation.—There are 18 varieties of mangos under trial in this station, including 7 Philippine varieties and 11 varieties of Indian origin, besides the several varieties recently imported also from India that are now in the plant shed awaiting permanent planting. All of these have grown very well at Lamao, but insect enemies attacking the twigs, leaves, and fruits, appear one after the other, keeping down the general health of the trees. The Indian mangos were observed to be more susceptible to the attack of these insects than the native varieties.

In addition to *Mangifera indica*, the station has a number of trees of *Mangifera odorata*, *M. verticillata*, *M. caesia*, and *M. foetida*.

One hundred forty-two plants consisting of both budded and seedling trees of native mangos were planted in the hill north of Field I.

Coffee—Variety test and selection.—There are twelve species of coffee under trial at Lamao, namely, Liberian, Excelsa, Abeocuta, Bukobensis, Dybowskii, Congo, Uganda, Canephora, Quillou, Robusta, Stenophylla, and Zanziberica. The Liberian, Abeocuta, and Excelsa coffees have borne fruits during the year. The first two varieties fruited for their first and second time respectively. Their yields were slight. The Excelsa coffee planted

late in 1916 bore its third crop this year and the individual tree yields were recorded. One tree produced as much as 21.7 kilos of berries while other ranged from .02 to 14.35 kilos and the remaining trees varied from .02 to 5 kilos. Many did not produce fruits because they were in poor condition, as they were too heavily shaded by the surrounding bamboo plants and some portions of the field were poorly drained. Wild cats and monkeys destroyed many of the berries—about 20 per cent of the total crop of 349.69 kilos.

Pineapples—(*a*) *Acclimatization and variety test.*—There were nine varieties of pineapples imported during 1920 from Calcutta, India, namely, the Singapore, China Green, Australian Smooth, China Red, Giant Providence, Ceylon Green, Ceylon Yellow, China White, and Striped Leaf. These were all transplanted from nursery beds to the permanent field in July, 1921. They are all making fairly good progress, though they are planted on sloping ground. Besides these varieties there were also imported during the year, from Porto Rico and India, a few slips of Cabezona, Sugar-loaf, Country Spineless, Mauritius and Kew Giant pineapples, which varieties are now under quarantine at Harrison Park, Manila. These varieties will be included in our variety test as soon as they are released.

(*b*) *Seed and plant propagation.*—The station maintains a field of Hawaiian pineapples about two hectares in extent. The plants growing in a well drained portion of the field are doing very well and suckers for distribution purposes are expected to be produced from this field next May (1922).

Root crops—(*a*) *Variety test.*—There are 49 lots under test in this experiment. The yields ranged from 3,800 to 31,400 kilos of tubers per hectare of the ubi, and from 3,900 to 26,300 kilos of the tugui. Basol ubi and tugui No. 1010 gave the best yields per hectare. All of these were poled and planted in ridges.

A fungus disease causing black spots on the leaves affected the namé and lepidopterous insects and grubs attacked the leaves and main stems of the ubi. The tugui seemed to be resistant to these disease and pests.

(*b*) *Cooking test.*—For culinary purposes, the following results were obtained:

Ubi: Dampol and Ubi-A are excellent in quality and flavor.
Ubi-B and No. 7241 come next in quality and flavor.
Tugui: Nos. 1239, 1057, 6916, and 1015 are excellent in quality and flavor.
Nos. 1057-A.M., 1057-A., 1010-A, and 1–7 are of very good quality and flavor.
No. 7249 Binato ubi and tugui I-S-M are fair in flavor.

Camote—Ipomoea batatas.—There are 27 varieties included in this experiment. The yields varied from 1,000 to 52,000 kilos of tubers per hectare. The Jersey Red gave the highest yield.

In addition to these, Momungan, Samar Big Yellow, New Jersey Yellow, Ucab, and Canegro camotes were planted during the latter part of the year.

Gabi—Colocasia esculenta Schott.—There are 19 varieties under trial planted on April 9, 1921, one meter apart. These have not been harvested but from present indications the gabi 1, 2, 3, and 4, the Palawan, Kinawayan, Katibe, T. Gabi and Guinaliang respond to the climatic conditions of Lamao. Recently, Cantonese and Tanhay gabi were also added to the collection. They are now being propagated in the nursery shed.

Yautia—Xantosoma sagitifolium Schott.—There are only three varieties under trial, and none have been harvested yet.

Cassava—Manihot utilissima Phol.—Twenty-eight varieties are now planted in a variety test at this station, but it is too early to report as to their respective yields. Though the varieties planted last May and July have matured yet no attempt has been made to record the results, because they were attacked by wild pigs, which have reduced the yields to a considerable extent. Another planting was made on December 2, 1921.

Vevetables—(*a*) *Hybridization of Eggplants.*—Three native varieties were used as females in this test and one American variety as male. The male parent was pink. The resulting hybrids were all pink though only one female parent was, the others, being light green, and apple green, respectively. From these results, it is evident that the male character with regard to color is domonant. The shape of the fruits of the hybrids is generally somewhat oblong, as are both parents. The same is true as to size and weight. As to resitance to wilt the male parent is very susceptible but the females are hardy. The resulting hybrids are much more hardy than the male parent and slightly less so than the female parents.

(*b*) *Acclimatization.*—There are 37 kinds of vegetables that were tried during the year. Many of the imported seeds failed to germinate and some of those that grew died later, due to the change of environment, perhaps. The *Amaranthus paniculatus*, Guada Bean and Japanese mungo have been quite successful under Lamao conditions.

Guada bean.—This is one of the many interesting plant immigrants. Though it is called "bean" yet it does not possess any characteristics of a bean. The fruit resembles that of the patola (*Luma cylindrica* Roem) having a smooth surface, and

being about 70 centimeters long and 5 centimeters in diameter. The plant is adapted to climatic conditions at Lamao.

Japanese mongo.—Of this introduction three plantings have been made. The first was in March, 1921. The crop was a failure. The second was in July. The plants were vigorous. The computed yield was 1,040 kilos seeds per hectare. The third planting was made in November. This crop was a failure also. July is evidently the time to plant this crop.

(*c*) *Seasonal planting.*—The results so far under Lamao conditions from the monthly plantings of pechay, endive, rape, petsai, cabbage, cucumber, uansoy, tango, eggplant, pepper, and tomato were as follows:

Japanese Mongo: July to October.	Eggplant: October to June.
Pechay: August to December.	Pepper: October to June.
Endive: June to August.	Tomato: October to June.

The above conclusions, however, do not mean that these vegetables may not be grown in other seasons, especially if given extra good care. They only show that the best results may be expected if the plants are set out during these months under Lamao or similar conditions.

(*d*) *Variety and planting distance tests.—Cabbage and Eggplants.*—Variety and planting distance tests of eight varieties of cabbage are under way. Twenty-one varieties of eggplants are included in this culture. The planting was done during the month of November, 1921, and therefore no data can yet be given.

(*e*) *Fertilizer experiment.*—A ball fertilizer made up in balls and advertised to contain 8 per cent nitrogen, 46 per cent soluble phosphoric acid, 10 per cent potash, and 34 per cent carbon dioxide was tried in a seed of plat of rape. The result was that the fertilized rape made about 25 per cent better growth than the unfertilized plants and the leaves were darker in color. However, this fertilizer can not be recommended for use in large quantities because of the high price. It is good for a person keeping a few plants, because it is convenient to handle.

Miscellaneous horticulture.—There are several orchards maintained at this station which contain about 150 species including about 200 varieties of fruit trees, exclusive of Citrus, Mangiferas, Anonas, and Coffee, that are treated of as separate topics on other pages of this report. Among the introduced fruit trees included in this collection which have come to fruiting, the following are considered the most important: *Persea americana*,

Annona hybrid, Chrysophyllum cainito, Nephelium lappaceum, Lucuma nervosa, Inocarpus edulis, Eugenia malaccensis Artocarpus polyphoema, Rollinia orthopetala, Carissa species, Diospyros discolor (Sdl. var.), Flacourtia ramontchii, Rheedia edulis, and *Psidium guava (2 var.).*

Among all the important tropical fruits, so far only the following are grown in considerable numbers and in solid orchards: avocado (35 trees), rimas (70 trees), tiessa (80 trees), and Caynito (60 trees, along the road).

Vegetative propagation experiment.—The results along this line of work during the year were as follows:

The Chinese litchi (Litchi chinensis) was successfully grafted on the laguan (Nephelium mutabile).

A good percentage of successful grafts were obtained by grafting the seedless mabolo on the seeded variety.

Sixty per cent of the Tahiti lime (Citrus aurantifolia) grafted on the *limoncito* (Triphasia trifolia) was obtained.

Cuttings.—Root cuttings of Rambutan (N. lappaceum) were successfully grown.

Marcottage.—During the rainy season the following were easily grown by marcottage: Chinese lemon, limon-real, calamondin, Tahiti lime, oranges, pomelos, yambo, rima, and yaruma.

Rice—(*a*) *Variety test of upland rice.*—Seventy-seven varieties were planted this year, of which eleven varieties were found to produce over 30 cavanes per hectare.

A considerable number of the seedlings were attacked by a disease which caused a gradual wilting of the leaves and rottening of the roots. Other diseases observed were the smut, mildew, and another fungus disease that spotted the leaves. But only a little of the smut was found.

(*b*) *Rice acclimatization and quarantine.*—The Californian rice, U. S. Department of Agriculture No. 1600, was planted on the quarantine ground November 25. A poor germination was noted. Better germination was registered of the seeds of the two Persian rices Nos. 1 and 2.

Corn—(*a*) *Propagation.*—During the year early part of this year a crop of some 46 cavanes of seed corn was produced.

(*b*) *Variety test.*—During the latter part of the year a number of corn varieties were received and separately planted in this station. No report can be given as to the results of this test inasmuch as the crops are still standing in the field and not yet ready for harvest.

Sugar cane—(*a*) *Propagation*.—In addition to a large number of seedling varieties of sugar cane in Lamao, Louisiana Purple, P. I. No. 161, Big Tanna, Hawaii–109, Hawaii–20, Luzon White, Negros Purple, and another lot of H–109 seed cane were also planted. In July, 1921, the presence of Fiji and Mosaic diseases made it necessary to destroy all standing canes, except a portion of the H–109 plot that was healthy.

Hawaii–109 cane is making a remarkable growth in Lamao and is decidedly superior in many respects to any of the native varieties that were ever planted there. A yield of 70.5 metric tons of cane per hectare has been produced from one-half hectare.

Forage crops.—Napier grass, Guinea grass, Uba cane, and Sudan grass were tried in the station for comparative yields.

The number of cuttings from each crop and the total corresponding yields per hectare were as follows:

TABLE XIX

Name	Average yield per cutting	Number of cuttings per year	Yield per hectare	Remarks
	Kilograms			
Napier grass	28,600	6	171,600	Planted 8-19-21.
Guinea grass	7,200	3	21,600	Ratoon crops.
Uba cane	6,200	2	12,400	Ratoon crops.
Sudan grass	1,100	2	2,200	First crop.

Miscellaneous agronomy.—Adlay was grown on 0.42 hectare area. The stand was somewhat thin but the growth of plants was good. The loss of grains due to shattering is believed to have been something like 50 per cent. Only 71 kilos of clean seed were collected, and this amount from a small portion of the field where the crop appeared the most prolific. A yield equivalent to 1,146 kilos of grain was all that could be obtained.

Other crops of minor importance grown in the station during the latter part of the year were ragi, sesame, milet, wheat, kodo, and cowpeas.

LA CARLOTA EXPERIMENT STATION

Rice—(*a*) *Variety test*.—Under the variety test there were planted 209 upland varieties of rice, of which 3 varieties were from the United States, 2 from China, 9 from Japan, 9 from Saigon, 5 from Siam, and the rest (181 varieties) native.

Because of the drought during the latter part of the season, some varieties did not produce a full crop. The following gave

a yield of over 50 cavanes of palay per hectare and a stand of over 80 per cent: Kinanda, Pan-ay, Kinastila IV, Daliket (or Sanglay), Inantipolo II, and Tapocoy.

(*b*) *Head-to-the-row test.*—Four varieties giving the highest yields in the variety test were submitted to a straight selection experiment in which the selected heads numbering five for each plant were planted in separate rows.

There was no increase made in the first year selection with Buluhan, Daliket, and Macan II. Corrected yields of Inantipolo II and Lubang Blanco showed an increase equivalent to 668 and 472 kilos respectively per hectare, due to selection.

(*c*) *Seed preservation work.*—A study of the containers to use for seed palay so as to best preserve its vitality was undertaken.

On November 25 the samples of five varieties of rice collected in October and November, 1920, were placed in baskets, cans, and gunny sacks; and bundles of heads of some varieties were hung up, and checks were provided for. It was found by the germination tests made subsequently of samples taken from the different containers and bundles that the grain kept in the baskets had the highest per cent of germination. The loss of vitality in the baskets was 44.5 per cent as against 63.7 per cent of the samples kept in cans and 55 per cent of that in the sacks.

(*d*) *Seasonal planting experiment.*—Seasonal planting was conducted without irrigation beginning with June, 1920, and ending with January, 1921. The crop planted in June was normal, it being the regular season for upland rice. The one planted in September was fair, but the November, December, and January plantings produced hardly any crop.

Rice vs. *adlay.*—Preliminary plantings with rice and adlay were made with a view to comparing their yields. The expenses connected with the work for each crop were also determined. Rice gives a much larger return than the adlay, according to the results.

Corn—(*a*) *Variety test.*—The dry season crops of the varieties Baluga Yellow, Cagayan Yellow, Calamba Yellow, Bohol White, Cebu White, and Moro White were planted in November, 1920, on one-half hectare areas. In July, 1921, the rainy season crops of the same varieties were planted on one-fourth hectare plots.

The dry season crop of Bohol White exceeded the rainy season crop. With this exception as may be seen by the table the other varieties yielded more during the dry season.

TABLE XX

Variety name	Yield per hectare based on 100 per cent stand (cavans)	
	Dry season	Rainy season
Baluga Yellow		
Cagayan Yellow	34.38	13.56
Calamba Yellow	22.90	17.85
Bohol White	27.99	85.74
Cebu White	31.58	19.00
Moro White	28.82	19.54

The crops planted in July did not give good results as the weather was unfavorable and certain portions of the crops were destroyed by animals and birds.

Previous records show that Baluga Yellow is the highest yielder with an actual average production of 31.55 cavanes of shelled corn, planted during the dry season. It also gives a fairly good yield during the rainy season and is an early cropper.

(*b*) *Ear-to-the-row-test.*—The Cebu White planted in May, 1921 was harvested in August, with a yield amounting to 32 cavans of shelled corn per hectare. Eleven rows were selected for the next year planting, producing not less than 10 kilos weight of ears per row. Cagayan Yellow was also planted in this test, but the crop is not yet harvested.

Sugar cane—(*a*) *Variety test.*—Forty-two varieties of sugar cane, mostly of foreign origin, were included in this test, and all the important data regarding physical characters were recorded for each. Over 1,000 samples of the 42 varieties were submitted to weekly sugar analyses.

In the following table is given the maximum percentage of sucrose found in the cane juice for each of the 15 varieties, and the corresponding month:

TABLE XXI

Variety name	Plant cane.		Ratoon crop	
	Month	Sucrose	Month	Sucrose
		Per cent		*Per cent*
Yellow Caledonia			April	17.19
Negros Purple	May	17.37	do	17.26
Cebu Purple	March	19.30		
Badila	April	19.20	February	17.35
Inalmon	February	17.75	March	15.60
Louisiana Striped	April	16.62	December	17.08
Java-247	February	16.04	May	19.40
Big Tanna-3525	March	33.36	February	15.34
Lahaina			April	16.39
Mindoro	April	19.89	do	20.30
Luzon No. 1	May	17.46	do	17.60
Hawaii-16	June	14.55	May	14.14
Hawaii-20	May	15.14	do	15.52
Hawaii-69	March	14.11	February	11.83
Hawaii-109	February	17.97		

(*b*) *Fertilizer test.*—Fertilizer tests on a large number of varieties in ratoon are in progress, an artificial fertilizer being used. Judging by the majority of the plots in the experiment the fertilizer has a stimulating influence upon growth.

The same fertilizer was applied to the Negros Purple cane at the rate of 500 kilos per hectare, in one portion of a lot. While the returns are not yet known it can be seen that the fertilized plants are more vigorous and with leaves of a deeper green color than the unfertilized ones. The stalks per stools are in the ratio of 4 to 3. Another effect of the fertilizer is that the flowers set earlier.

(*c*) *Hybridization work.*—Attempts have been made to cross Yellow Caledonia and Negros Purple, two varieties of cane presenting desirable characteristics for a combination, by placing the plants together and allowing a natural crossing to take place under control.

(*d*) *Propagation of seedling canes.*—Seeds of Hawaii–16, H–27, H–109, Inalmon, and Badila have been planted. The resulting plants exhibit some variations from the original types. Certain stools possess desirable characteristics.

Miscellaneous agronomy.—The wheat received from Cagayan made a fair growth and nearly half of a kilo of seed was harvested from the planting. This seed was planted in September but did not grow. Kodo, a new grain from India, did fairly well at La Carlota.

Forage crops.—Those grown in regular plots were the Bungalon, a native species of promising aspect, Uba cane, *Paspalum dilatatum,* and Napier grass. The Guinea and Para grasses are growing naturally in the borders of fields once cultivated to them. The Napier, a new introduction, seems sufficiently neutralized to compare favorably with the Uba cane.

Seed growing.—In adopting the tenant system of working portions of land not actually cultivated by the station, the end in view was to clear as much of the land as possible at little expense to the Government and at the same time get the benefit of a share of the crop. Two hundred ninety-seven cavans of seed palay and 16,552 kilos of corn in the tenants' plots were obtained.

Mangos—The value of the mango as shade tree.—There is no regular mango project maintained at this station, but mango plants are set out along the station roads and fence of the cattle corral for trial purposes as shade trees. Many of the mangos along the provincial road have been destroyed, but the remaining trees are in a fairly good condition.

Coffee variety test.—Canephora, Robusta, Uganda, Congo, Quillou, Excelsa, and Abecuta coffees are under trial. The yields of each variety have been recorded separately.

Root crops—Variety test.—The results may be seen in the following table:

TABLE XXII

Variety name	Computed yield in kilos per hectare
Manihot utilissima:	
Rough Intermediate	11,800
Kapo White or Green	36,600
Kapo Colorado or Red	27,000
Angular	14,000
White Smooth Intermediate	29,000
Biscuit	14,000
Cassava Red	26,000
Cassava white	11,500
Ipomoea batatas:	
Inadsay	2,500
Linoco	2,700
Mallon	2,900
Tuguicao	3,800
Dioscorea species:	
1-Batangas	27,000
871-B	14,000
1010	21,600
1011	14,900
1013	9,000
1015	13,800
1017-C	14,000
1037-A	5,300
1037-B	7,300
1057-A	3,500

The different varieties of cassava have done pretty well during the year. The Kapo White or Green still holds the lead in yielding capacity as last year.

Georgia Yellow yam, Mintal, Momungan, and New Jersey sweet potatoes were planted and also the Ubi variety Binanug, Binato, Cebu, Quinalabao, Sampanuanon, and Minanog. Five varieties of yautias, namely, Gray Jack, Trinidad Yellow, Rolliza Blanca, Taro Royal, and Rolliza Yautia were also set out. The yautias are doing especially well and on some varieties tubers are fast developing.

Miscellaneous cultural tests.—Arrowroot, sembu, gabi, and Irish potatoes are also being tested. Two kilos of roots were harvested from a hill of sembu. The Irish potatoes planted in January have produced 1,638 kilos of tubers from 480 square meters of ground.

Vegetables—(a) Acclimatization work.—The following varieties of vegetables were tried during the year: Artichoke hybrid, *Asparagus palmetto*, Baled, Beets, Chick pea, Egypt White

Lima, Guada bean, Rape, Sword bean, Anaheim pepper, Tashiro soy bean, and nine different strains of soy from Japan, Due to insect attacks and unfavorable weather conditions some of the above varieties did not produce seeds though they flowered. However, the *Asparagus palmetto*, Egypt White Lima, Guada bean, Sword bean, Anaheim pepper, Rape, Tashiro soy bean, and the nine strains of soy have done fairly well considering this was their first or second trial only at this station.

Of the different strains of soy, the P. I. No. 7765 gave the best yield over the others, 318.9 grams of clean seeds having been harvested from 40 square meters of ground.

The Rape grew very well though worms did it some slight damage. Lead arsenate powder was used with good effect. The plants died without producing flowers, however. A second crop was planted and is now in very good condition and about 20 centimeters high.

(*b*) *Variety test and seed growing.*—There were also raised during the year

Cucumber:
- Prolific.
- Prolific Green.
- Nepaul.
- Rungpur.
- Telegraph.

Eggplant:
- Long Purple.
- Large Yellow.
- White.
- White 1.

Muskmelon:
- Honey dew.
- Spanish.
- Muskmelon.

Squash:
- Boston Marrow.
- Long Native.
- Round Native.

Tomato:
- Native.
- Perfection.
- Tree Champion.

A more or less limited area was planted to the following seeds: Atab black, batao, cowpeas, kibal, Lamao Lima, La Granja bean, large hybrid, Lyon bean marutong, mongo, Palawan bean, white patani, seguidillas, tahore bean, patola, pepper, and upo.

Miscellaneous horticulture—Variety test of banana (*Musa* sp.).—There are 158 plants under trial, including the bungulan, cadiznon, gloria, lacatan, latundan, lisuhan, morado, pastilan, saba, and todlo dalaga. The plants are all in excellent condition.

Other tropical fruits.—There are 63 distinct varieties of tropical fruit trees being cultured at this station making a total of 181 plants. Several have fruited successfully and are in from fair to good condition.

Acclimatization work—Centrosema plumieri—Crotalaria anagijroides (3 varieties), *Eroumcensis esculenta, Tephrosia candida, T. Hockeriana, Ceratonia siliqua* and Sunflower have been tried during the year. All have done nicely at La Carlota except the C. *siliqua.*

DAMMAO TOBACCO STATION

Tobacco—(a) Seed propagation work.—The production of high grade leaves and suitable seeds for free distribution is the principal work of this station. Considerable areas were planted to the established native varieties like the Dammao Large Broadleaf, Dammao Small Leaf, Espada Dammao, etc. In addition to these there were also grown on a small scale well known varieties of foreign tobacco like Florida Sumatra, Connecticut Seedleaf, Connecticut Broadleaf, etc.

A total of 367 *fardos* and 20 *manojos,* with a net weight of 5,697 kilos, was the crop; besides, there was a total production of about 500 kilos of seed.

(*b*) *Variety test and acclimatization work.*—Twenty-seven varieties in all, including the newly introduced Ceylon Tobacco and Olsen No. 1, were tested.

It has been the aim of the station to make as complete investigations as possible of the worth of each of the varieties particularly as regards their capacity to produce the maximum amount of wrapper leaves which are so much in demand. One special feature of the work this year has been the determining of the resistance or susceptibility of the plants to fungus diseases.

The native varieties which produce a good quantity of leaves of good quality are Dammao Broadleaf, Malalatang Espada Bacalao Pampano, Anipa Broadleaf, Angadanan, Medium Fine Dammao, Romero, Espada Dammao, Echague, and Caoayan.

The first three named varieties have the defect of having leaves with too uneven a surface to make a good wrapper.

(*c*) *Selection work.*—Preparatory to breeding work a selection from the mass was made for plants showing ideal types of well-known varieties of tobacco. At least 15 plants of each variety of the following named varieties were selected: Florida Sumatra, Sumatra, Connecticut Havana, Dammao, Large Broadleaf Medium Fine Dammao, and Anipa Broadleaf.

(*d*) *Sterilization experiments.*—Experiments were conducted this year to see what chemical disinfectants might do in the way of sterilizing the soil in the seed bed to prevent fungus diseases like the so-called damping-off disease, leaf rot, root rot and *Cercospora nicotiana.*

A solution containing 1 part of formalin and 50 parts of water, as a drench in the seed bed, checked the development of fungus and growth of weeds. A weaker solution containing 1 part of formaline to 150 and 200 parts of water was without effect.

Trials were also made with an application of arsenate of lead in the proportion of 1 part of arsenate of lead to 50 parts of water. This proved successful in preventing insect pests and worms from eating the leaves.

(*e*) *Cultural treatment of seed beds.*—It was observed that the tobacco seed sown in a shaded seed bed germinated earlier and gave a greater percentage of germination than the seed sown in an open seed bed. Good results were obtained in growing seedlings in the sun by keeping the soil moist and covering the bed towards noon for at least 6 successive days. Restricting the number of seedlings in the seed bed was found necessary as the plants became spindling and weak and were more frequently attacked by fungus, when sown too thick.

(*f*) *Corn and cassava as shade crops.*—Neither makes a shade crop for the production of wrapper, as shown by an experiment made at Dammao. Despite the proper spacing given, the tobacco leaves produced between the rows of corn and cassava plants had uneven color, and some of the tobacco plants were damaged by the uprooting and falling of the corn and cassava plants during high winds. With the cassava planted side by side, the tobacco plants had a stunted growth.

(*g*) *Stalk curing experiment.*—A crop of 265 plants of the variety Anipa Broadleaf was topped on April 25, 1921, at the right stage, leaving an average of 11 leaves to plant. On April 28 the first four leaves were primed. On May 10, the topped plants were cut. In harvesting the stalks with the leaves it required one minute to cut and another minute to collect 6 to 7 plants. Wilting took place in from 10 to 17 minutes.

As to poling the stalks with leaves, the average time spent in spearing 15 stalks (which is the proper number to have on 1 meter pole), varied from 3 to 4 minutes. The average number of leaves was 146.

By air drying methods the primed lower leaves were cured in 26 days counting from the date they were set on poles. But the leaves on the stalk were cured in 35 days.

Considering the quality of the finished products obtained from poled stalks that were inferior, this method of curing, though less elaborate and more economical, is not to be recommended.

(*h*) *Air drying* vs. *sun drying.*—This test was performed in April, 1921. The leaves wilted in the sun have, after 26 days in the curing shed, become spotted, lifeless, and brittle and had no uniformity of color, while those which were placed in the curing shed right after priming were more or less uniform in color and cure, and were flexible and without spots.

(*i*) *Public seed beds.*—The station is maintaining seed beds of nearly one-half hectare in size for raising seedling for free distribution. This practice has been effective in inducing the tobacco planters to use the varieties of tobacco recommended by the Bureau.

COTABATO TOBACCO STATION

Tobacco—(*a*) *Variety test.*—The following varieties were tried and cultured at the station: Florida Sumatra, Dammao Broadleaf, Medium Fine Dammao, Connecticut Broadleaf, Connecticut Seedleaf, Havana, Repollo, Olsen No. 1, and Havana Wrapper.

Of these, Florida Sumatra and Dammao Broadleaf gave the best results. Florida Sumatra produced over 11 per cent of the crop suitable for wrapper and Dammao Broadleaf gave 3 per cent. The crop of Florida Sumatra is remarkable when it is considered that the variety is still in the process of acclimatization. It contains many types and better results may be expected from this year's crop of selected strains.

(*b*) *Hybridization.*—Besides the remarkable results obtained with Florida Sumatra and 16 strains of other varieties isolated from the general culture, the station has been able to lay special stress on cross-breeding with a number of good varieties, using the Florida Sumatra and Sumatra Wrapper as the foundation stock, to produce wrapper of quality equal at least to the imported leaves. There have been newly introduced at the station Connecticut Round Tip, P. I. No. 7836 A and B, Batoli and Baker's Sumatra, which are all believed to be valuable material for this work.

BONTOC SEMI-TEMPERATE FRUIT STATION

Vegetables—Acclimatization work.—Cauliflowers, kale, Brussels sprouts, rape, chayote, soy beans (9 strains), garbanzos, and potatoes have been tried but so far only the soy beans, potatoes, and the Brussels sprouts are making a fair growth.

Miscellaneous horticulture—Acclimatization work.—The following plants have been planted either in the nursery shed or in the permanent orchard during the year: apples (13 varieties), peaches (5 varieties), pears (11 varieties), cherries (8 varieties), plums (4 varieties), kaki (1 variety), grapes (6 varieties),

currants (2 varieties), raspberries (2 varieties), walnuts (3 varieties), lemon (1 variety), loquat (1 variety), prunes (1 variety), chestnut (1 variety), strawberries (5 varieties), laurel (2 varieties), figs (8 varieties), pecans (1 variety), olives (4 varieties), oil plant (1 variety), cyndra (1 variety), cactus (1 variety), Amaranthus (1 variety), sunflower (1 variety), apricots (2 varieties), almond (6 varieties), quinces (2 varieties).

Many of these varieties of semi-temperate plants are thriving though others failed to grow because of the poor conditions of the seeds and plants when received at the station.

PANGASINAN RICE BREEDING STATION

Rice.—The Pangasinan Rice Breeding Station is engaged in the cultivation of the selected rice produced at the Alabang Central Rice Breeding Station on a large scale, in the improvement of the varieties found adapted to the region and in the study of cultural methods. The station has been conducting the following experiments:

(*a*) *Variety test.*—One hundred lowland and ten upland varieties are under this test. The crops as a whole are good, but some of the varieties were damaged by the flood in August. The majority of the varieties tested are late maturing and only some 40 varieties have been harvested so far. The region is not suitable for the early rice varieties.

(*b*) *Dry season experiment.*—In March, 1921, about one hectare of land was planted to four non-bearded and three bearded rices. The seedlings were transplanted and sufficient water was given to the plots until the crops came near maturing time. The results of the experiment were as follows:

TABLE XXIII

Variety name	Days to maturity	Yield per hectare
		Kilos
Apostol	223	1,760
Mangasa	134	2,596
Binicol II	143	------
Dinagat	132	1,144
Pinili	150	1,804
Saigorot	105	528
Lampaden	145	616

In this experiment the Mangasa variety gave the highest yield—59.5 cavans to the hectare.

(*c*) *Fertilizer experiment.*—A chemical fertilizer containing 10 per cent of nitrogen, 8.5 phosphoric anhydride, and 3.7 per cent of potash was used in this experiment, and the variety of rice planted was Cruz. The plot had an area of 2,000 square

meters. Different amounts were applied, and to note the effect a check plot was used. The application was made just before the seedlings were transplanted. The table below gives the results of the experiment.

TABLE XXIV

Number of plot	Rate per hectare (Kg.)	Crops yield per hectare
1	None	1,810
2	100	1,885
3	200	1,870
4	300	1,280
5	400	1,560
6	500	1,930

It appears from the above figures that the application of 500 kilos of the fertilizer gave a margin of 120 kilos of grain over the check plot. As the price of this fertilizer was ₱.25 a kilo, it is easy to see that this excess in the production did not pay for the cost of the material. Plots No. 4 and 5 gave poorer results even than the check plot because they were flooded. The experiment will be repeated so as to secure more accurate data as to the proper rate of application.

(*d*) *Seed growing.*—Apostol has been planted to an area of 1,200 square meters; Cruz, 22,000 square meters; Roxas, 15,000 square meters; Conner, 3,300 square meters; Piniling Daniel, 1,200 square meters. Due to lack of funds the harvesting and threshing was carried on by share system. There was greater crop produced this year but the amount cannot be given in this report, as the palay is not yet threshed.

About 11 hectares of the station were worked by tenants this year under the direct supervision of the station superintendent.

(*e*) *Cover crop in rotation with rice.*—The station is conducting cover crop experiments. After harvesting the rice, certain portions of the fields were planted to mongo, by broadcasting. Some ten cavans of seed were produced, which were sent to the Central Office for distribution, and the vines were plowed under the soil as green manure. This experiment is still in progress.

SAN PABLO LANZON STATION

Plant propagation.—There were about 10,741 lanzon seeds sown either in seed flats or beds and some 5,131 seedlings were gathered from the different plantations and transplanted to beds where they will be budded as fast as they are established. About 500 out of these 5,131 seedlings are now ready for grafting.

BATANGAS COMMERCIAL CITRUS STATION

Citrus—(*a*) *Cultural treatment of a run-down mandarin orchard.*—The trees in the plot where cultivation was practiced that were set out to cover crops exhibited more vigorous growth than those trees where cleaning around the individual trees only was done and those left untreated. Moreover, most of the cases of bark-rot disease were found in plots not cultivated.

(*b*) *Bark-rot disease investigation.*—Bark-rot was more apparent during the dry than during the rainy season. The affected trees shed their leaves at the close of the rainy season, giving no chance for the fruit to mature. The oozing of the diseased parts of the tree was very distinguishable during the dry weather. Good results were obtained by treating the trees with a chemical mixture.

(*c*) *Variety test orchard and stock trials.*—The stock experiment has its objects to find out the comparative value of the different stocks under Batangas conditions, and the most suitable variety of stock for each of the commercial varieties of citrus. Calamondin, rough lemon, mandarin, sour orange, pomelo, sweet orange and *Citrus trifoliata* stocks are under trial. There are altogether 50 plants consisting of pomelo (3 varieties), sweet orange (5 varieties), lemon (3 varieties), lemon-real, grape-fruit, calamondin, lime and mandarin orange budded on rough-lemon, calamondin, pomelo, mandarin and *Citrus trifoliata* that were set out in the variety test orchard this year.

A budded mandarin orchard has been established in connection with the work at this station. In this orchard again different stocks will be tried for the selected Batangas mandarins. There have been set out during the year 53 mandarins budded on mandarin, rough lemon and calamondin stocks. Later on it is intended to bud selected Batangas mandarin, also on the sweet orange, rough-lemon, sour orange stocks.

CEBU CORN BREEDING STATION

Corn.—The total area planted to corn this year was 2.4413 hectares. Nearly a hectare was harvested and the rest is under cultivation. Small plots with an aggregate area of 462 square meters are under forage crops.

(*a*) *Relation of flinty and starchy corn to selection.*—Cebu corn was used in this experiment. Seeds of the two types were planted in alternate rows so that the flinty kernels occupied the odd rows and the starchy ones constituted the even rows. The

rows were a meter apart and the hills one half meter. It was determined by this experiment that (1) the starchy type gives a higher yield of grain than the flinty type per unit area; and that (2) it has a higher per cent of the large kernels than the flinty; thus there is a correlation of size of kernels to yields.

(*b*) *Observations of the extent of weevil destruction.*—The susceptibility of the two types to the attacks of weevils was tested for and it was shown that whereas the flinty kernels suffered a destruction equivalent to 15.45 per cent, the intermediate type lost 30.70 per cent and the starchy type lost 53.85 per cent. The materials were taken from a pile built 6 months prior to the making of the experiment.

(*c*) *Spacing experiment.*—The rows in this culture were one meter apart, the variation in spaces with the planting of the hills ranging from 25 centimeters to 75 centimeters. Only one variety was tested—the Cebu white corn.

TABLE XXV

Plot No.	Spacing	Number of plants per hill	Per cent stand	Computed yield per hectare
				Kilos
1	1 m. x 25 cm.	1	54	851.60
2	1 m. x 50 cm	2	61	480.01
3	1 m. x 50 cm.	3	55	284.05
4	1 m. x 75 cm.	4	15	166.45

(*d*) *Cowpeas inter-planted to corn.*—A high production of corn has been obtained from check plot. The average computed yield of the cowpea inter-planted plots was 31.78 cavans of dry shelled corn. The yield of the check plot was three-fourth cavan higher. Thus the benefit to be derived from planting cowpeas in the corn field must be looked for in the effect it will have on the succeeding corn crops.

ISABELA CORN BREEDING STATION

Corn—(*a*) *Variety test.*—Of the six varieties tested Ilagan White, which gave 43.6 cavans of shelled corn per hectare and Cagayan Yellow which gave 48.6 cavans, proved the best. The four other varieties tried were the Calamba Yellow, Cebu White, Moro White, and Baluga Yellow flint corn.

(*b*) *Ear-to-the-row test.*—In this experiment a pure strain of Ilagan White corn was isolated after selection work based upon the productive capacity of the individual plants. No results can be given at this writing.

(*c*) *Seasonal planting test.*—Only Ilagan White corn was employed in this experiment as this variety is the best in the

locality. Planted on May 29 and on June 17, it gave 45.2 and 34.8 cavans of shelled grains a hectare, respectively, computed on actual stand, and 52.56 and 45.50 cavans, respectively, when computed to 100 per cent stand. The July and September plantings gave poor results.

(*d*) *Detasseling experiment.*—The detasseling of the plants in every other row gave an increase over the control plots. This increase is 3 cavans on a hectare planting, calculated on the actual stand and 6.20 cavans calculated on a 100 per cent stand.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION

The work on seed and plant introduction and distribution is one of the most important features of the activities of the Division. Such seed and plant materials as it is thought may be grown in the Philippines are introduced for trial, and for distribution of the resulting plants and seeds, if any.

During the year 1921, the following seed and plant materials were introduced from abroad:

I. FRUIT TREES

Avocado: 18 seeds.		
Citrus (5 varieties):		
Plants		12
Seeds		100
Budsticks		5
Mango (16 varieties):		
Plants		46
Budsticks		239
Pears (16 varieties):		
Plants		56
Seeds	kilogram	½
Juglands (4 varieties)	plants	8
Cherries (13 varieties)	do	26
Apples (25 varieties)	do	40
Plums (5 varieties)	do	12
Almonds: (5 varieties):		
Plants		10
Seeds		9
Raspberries (2 varieties)	plants	4
Peaches (8 varieties):		
Plants		18
Seeds		100
Strawberries (8 varieties)	plants	16
Apricots (2 varieties)	do	4
Quinces (2 varieties)	do	4
Grapes (8 varieties)	do	16
Currants (2 varieties)	do	4
Loquat (4 varieties)	do	26
Pineapple (4 varieties)	slips	47
Duku	seeds	48

I. FRUIT TREE—Continued.

Miscellaneous:		
Plants		36
Seed:		
No.		20,746
Kg.		7.10
Budsticks		252
Tubers		3

II. FIELD CROPS (SEEDS)

Cowpea	kilograms	1.9
Soy bean	do	9.85
Ragi	pounds (seeds)	250
Rice	kilos (seed)	54
Tobacco	packets	2
Wheat	pounds	1,440
Miscellaneous	seeds	200
Do	kilos	3.74

III. VEGETABLE AND FRUIT (SEEDS)

Watermelon	grams	140
Muskmelon	do	10
Kale	kilograms	5
Rape	do	5
Brussels sprouts	do	5
Garbanzos	do	50

IV. MISCELLANEOUS

1. Seeds:		
No.		27,336
Kg.		2.25
Fruits	grams	5

SEED AND PLANT DISTRIBUTION

The following seed and plant materials were distributed by the Plant Industry Division during the period of January to December, 1921, inclusive:

Kind.		Quantity.	Value.
Vegetable seeds:			
Ampalaya	kilos	.10	₱.75
Bean, Batao	do	28.80	8.64
Bean, Canadian Wonder	do	263.87	343.03
Bean, Horticultural	do	55.90	72.67
Bean, Kentucky Wonder	do	200.20	300.30
Bean, Lima	do	22.90	18.32
Bean, Marutong	do	3.40	.85
Bean, Soy	do	11.90	4.17
Beet	do	27.76	99.94
Cabbage	do	48.35	1,078.31
Condol	do	12.10	48.40
Cucumber	do	22.10	233.35
Eggplant	do	29.30	243.19
Endive	do	26.65	101.27
Kale	do	.70	3.50
Kinchay	do	19.60	78.40

Kind.	Quantity.	Value.
Vegetable seeds—Continued.		
Lettuce ......kilos....	47.65	₱190.60
Mustard ......do......	65.04	344.71
Muskmelon ......do......	5.20	10.40
Onion ......do......	22.90	144.27
Patola ......do......	7.80	34.32
Peas ......do......	61.80	92.70
Pechay ......do......	91.06	473.51
Pepper ......do......	23.01	517.73
Radish ......do......	160.57	240.86
Roselle ......do......	25.40	222.25
Seguidillas ......do......	38.90	11.67
Squash ......do......	21.20	42.40
Tañgo ......do......	13.30	162.40
Tomato ......do......	18.60	200.88
Turnip ......do......	2.40	6.00
Uansoy ......do......	16.67	68.95
Upo ......do......	4.40	17.60
Watermelon ......do......	42.00	84.00
Cereals:		
Adlay ......do......	116.4	25.30
Corn ......cavans....	222.78	1,742.83
Millet ......kilos....	8.6	19.46
Ragi ......do......	60.6	14.18
Rice ......cavans....	2,717.0	16,050.87
Sorghum ......kilos....	10.0	5.52
Wheat ......do......	122.5	67.38
Forage crops:		
Guinea grass ......rootstocks....	53,800	158.58
Napier grass ......cuttings....	50,984	154.94
Uba (Japanese forage cane) ......do......	3,500	10.50
Cover crops:		
Cowpeas ......kilos....	818.00	216.78
Lyon bean ......do......	3.00	.90
Kibal ......do......	314.70	155.43
Velvet bean ......do......	3.60	.90
Mongo ......do......	750.10	307.62
Peanuts ......do......	404.00	81.33
Fruit trees:		
Avocado ......plants....	216	104.40
Bananas ......do......	18	3.60
Cacao ......pods....	200	30.00
Do ......plants....	1,952	404.00
Citrus (different varieties) ......do......	1,234	349.66
Coconut ......nuts....	805	77.28
Coffee (different varieties) ...... kilos (seeds)....	92.70	255.40
Do ......plants....	20,008	2,439.52
Lanzon ......do......	514	131.63
Papaya ......kilos (seeds)....	23.40	112.32
Do ......plants....	36	3.60
Pineapple ......do......	2,586	195.05
Rimas ......do......	47	139.00

Kind.	Quantity.	Value.
Miscellaneous seed and plant materials:		
Cassava ....cuttings....	200	₱2.00
Tobacco ....kilos (seeds)....	54.85	28.25
Sugar cane ....cuttings....	431,342	4,305.75
Sweet potatoes ....kilos (tubers)....	116	87.75
Do ....cuttings....	12,384	62.20
Miscellaneous:		
Plants	9,438	1,590.66
Total		35,703.30

RECOMMENDATIONS

1. That a humid fruit station be established wherein there may be assembled humid climate fruit trees, such as the lanzon, mangosteen, duku, marang, bauno, kayam, durian, rambutan, bulala, juani, gandaria, rambi, Brazil nuts, and the like, and also coconuts, rubber, oil palms, and allied plants, as a second crop.

2. That a coffee station be established with a view to encouraging the coffee industry in the Islands.

3. That a technical man be sent to Java, Sumatra, China, Japan, and India and, if possible, to Ceylon to make horticultural and agronomical investigations in these different countries.

DEMONSTRATION AND EXTENSION DIVISION

ACTIVITIES

(*a*) Demonstration stations.
(*b*) Coöperative demonstration plots.
(*c*) Provincial and municipal nurseries.
(*d*) Food production campaign.
(*e*) Tobacco propaganda work among the growers.
(*f*) Organization and supervision of agricultural clubs.
(*g*) General farming advisory work.
(*h*) General field assistance to other divisions of the Bureau.

PERSONNEL

The personnel carrying on the work of this Division at the beginning of the year covered by this report consisted of:

1 Chief of division.
1 Assistant chief.
3 Supervising agricultural agents.
41 Farm advisers (6 acting).
107 Agricultural assistants.
31 Tobacco inspectors.
2 Clerks.

Two more farm advisers and 9 agricultural assistants were appointed later. For lack of funds, however, it was found neces-

(*a*) A view of Damao Tobacco Station. Damao, Gamu, Isabela

(*b*) Hybrid seedlings (at the middle) and Apostol (No. 1001) and Cruz (No. 1003) varieties

(*a*) Cacao seedlings in bamboo tubes at the Provincial Nursery of La Union

(*b*) Left: Millet (Dawa) grown for the first time at the Provincial Nursery of Cebu-Height, over two meters. Center: Sincamas Plot. Right: Adlay Plot

sary to separate from the service, during the first seven months of the year, 22 temporary agricultural assistants and 9 tobacco inspectors. For the same reason, 13 temporary agricultural assistants were dismissed at the close of 1921. Besides these, during the year, 9 agricultural assistants and 2 tobacco inspectors resigned 1 agricultural assistant and 1 tobacco inspector were discharged for cause. Two agricultural assistants and 2 tobacco inspectors were reinstated. Comparing the total number of personnel who rendered service from the beginning to the close of 1921 with the total number of workers for the same period during 1920, that for 1921 was less by 31 men.

ORGANIZATION

The chief of division, the assistant chief, two farm advisers, and the two clerks were stationed in the Central Office and the rest in thirty-eight provinces. To each of these provinces a farm adviser was assigned, as heretofore, with one or more assistants, the number of the latter depending principally on the size of the province concerned. The Mountain Province and Ilocos Sur (including Lepanto-Amburayan) had two farm advisers each because of their size.

The work of the farm advisers and agricultural assistants and tobacco inspectors was directly supervised by the supervising agricultural agents, of whom there were three during the major part of the year. The effectiveness of the supervisory work left much to be desired owing to the inadequate number of such supervising agents. It was for this reason that Antonio Derecho, former farm adviser for Leyte, was appointed acting supervising agricultural agent last October to supervise the work in the Eastern Visayas.

RESULTS OF WORK

COÖPERATION PLOTS

From the inception of the Demonstration and Extension work, it has always been the practice to secure every year what has come to be known as coöperative plots from farmers in different towns or barrios, which plots are worked and planted by the farmers themselves with the assistance of, and according to methods suggested by, a farm adviser or his assistant, and usually are alongside other plots cultivated entirely after the farmers' own way. The idea in this connection is to demonstrate to interested parties the contrast between improved and unimproved methods.

The following is a tabulation bearing on the coöperative plots attended to by the fieldmen of this Division during the year just ended:

Kinds of crops	Number of plots	Area of plots in hectares	Average yield per hectare	Average yield per hectare adjacent fields
Rice	988	1,299	38 cavans.	29 cavans.
Corn	578	537	23 do.	13 do.
Tobacco	140	61	3,612 kilos.	2,912 kilos.
Sugar cane	82	105	40 piculs.	25 piculs.
Vegetable	154	55	2,470 kilos.	2,232 kilos.

DISTRIBUTION OF SEEDS AND PLANT MATERIALS

The following materials were distributed to the farmers by the field force of this Division during the year:

Coffee seedlings		247,327
Camote cuttings		223,540
Vegetable seedlings		79,069
Sugar-cane points		46,130
Ornamental cuttings		20,000
Cacao		8,924
Napier-grass cuttings		7,500
Citrus		5,599
Nangca		5,690
Pineapple slips		5,285
Kapok		4,560
Mango		3,123
Guinea-grass rootstocks		3,036
Tobacco seedlings		2,150
Coconut		1,916
Cassava cuttings		1,875
Annonaceous plants		1,607
Santol		993
Jackfruit		938
Eucalyptus		300
Lanzon		254
Miscellaneous seedlings		1,600
Vegetable seeds	packets	21,701
	kilos	52
	and gantas	4
Papaya	packets	1,707
	and gantas	16
Peanuts	cavans	71
	and packets	40
Mongo	cavans	4
	and packets	60
Guinea grass	grams	1,060
Corn	cavans	29
	and ears	7,599
Cowpeas	cavans	2
	and packets	4,489
Other kinds of beans	packets	4,139
	and cavans	5
Root crops	kilos	187
	and shoots	1,311

These results are quite encouraging especially when it is considered that the distribution was made largely by sale. The sources of these materials were the Bureau of Agriculture, the provincial and municipal nurseries and also private persons having good seeds and seedlings.

At the close of the year, there were the following seed and plant materials available for distribution:

Fruit-tree seedlings		178,796
Vegetable seedlings		18,621
Tobacco seedlings		11,600
Cassava cuttings		5,621
Camote cuttings		340,000
Banana seedlings		270
Sugar-cane points		95,750
Fruit-tree seeds	kilos	6
	gantas	2
	and packets	305
Rice	cavans	32
Corn	cavans	16
	and ears	38,880
Millet	gantas	13
Legumes	sacks	3
	and gantas	4
Peanuts	cavans	4
Vegetable	packets	6,585

HOME GARDENING

Great emphasis was placed on this feature of the work in view of its importance to the people of the Islands. The total number of home gardens established as a result of the campaign in this connection is 170,772. In addition, this Division's field force assisted in treating, pruning and grafting some 15,300 trees of economic value. They coöperated also in the planting of the following trees:

Coconut	1,007,950	Santol	7,897
Bananas	896,001	Guanabano	7,694
Coffee	318,242	Breadfruit	6,702
Cacao	70,874	Lanzon	4,816
Camanchile	46,665	Pili nut	2,161
Citrus	57,536	Chico	1,685
Annonaceous	30,037	Mabolo	1,661
Papaya	25,968	Kapok	1,372
Jackfruit	12,343	Rimas	979
Mango	11,849	Casoy	784
Pineapple	10,813	Miscellaneous trees	907,000

SEED SELECTION

The following tabulation shows the accomplishment in this connection:

	Farmer helped	Amount selected
Rice	6,970	3,299 cavans and 1,470 bundles.
Corn	6,471	324,271 ears and 2,338 cavans.
Fruit tree	1,616	270,142 nuts and 6,900 seeds 1,700 fruits.
Sugar cane	1,567	237,140 points.
Tobacco	524	3 cavans 18 gantas and 17 kilos.
Vegetables	694	4 cavans, 152 kilos and 520 packets.

As to the educational campaign for the raising of better breeds of livestock and poultry, some 70 sows, 2 mares, 20 bulls, and 300 chickens were selected by farmers with the aid of this Division's agents.

The farm advisers helped in the organization and development of the following clubs:

Woman's clubs	364	Poultry clubs	411
Civic clubs	515	Swine clubs	232
Farmers' clubs	436		

Another worth-while activity of farm advisers and agricultural assistants is in connection with simple irrigation systems. Two hundred and fifty seven irrigation dams, capable of irrigating some 18,000 hectares were planned, finished or repaired through their coöperation during the year.

FARM IMPLEMENTS

Forty-nine thousand two hundred and nine iron plows were purchased during the year by different farmers. It is believed that no little credit is due the farm advisers and agricultural assistants for this, inasmuch as it has been a part of their educational campaign to induce people to use better farm implements.

LECTURES OR CONFERENCES

Farm advisers and agricultural assistants are required to deliver talks, whenever there is an opportunity, on such agricultural subjects as would be of interest to farmers in a given locality. During 1921, they talked at 2,543 meetings of farmers and at 1,222 school agricultural clubs.

The results of the work at the three demonstration stations managed by this Division may be seen from the following tabulation:

LIPA DEMONSTRATION STATION

[Established in 1914. Area, 5 hectares]

Total amount of collection from sales of grown crops	₱101.60
Estimated value of seedlings distributed gratis	3,878.82
Estimated value of seeds distributed gratis	796.80
Total gross income	4,777.22
Total expenses incurred	3,160.00
Income	1,617.22

LA PAZ DEMONSTRATION STATION

[Established 11 years ago. Area, 6 hectares]

Total amount of collection from the sales of grown crops	₱2,853.68
Estimated value of seedlings distributed gratis	68.50
Estimated value of seeds distributed gratis	287.03
Estimated value of products available for sale or for distribution	985.05
Total gross income	4,194.26
Total expenses incurred	2,720.75
Total net income	1,473.51

SANTA CRUZ DEMONSTRATION STATION

[Established January, 1921. Area, ½ hectare]

Plants permanently planted in the nursery	avocado	5	
	bananas	107	
	coffee	69,169	
Fruit tree seedlings distributed gratis		420	
Fruit tree seedlings available for distribution		2,596	
Total expenses			₱589.00

For lack of the necessary funds, the Santa Cruz Demonstration Station, and the provincial nurseries of which there were 15, and municipal nurseries, 22 in number, failed to give the satisfaction expected. Considerable amount of seedlings were distributed from them, however.

DIFFICULTIES

Some of the main difficulties confronting this Division in carrying on its activities are as follows:

(1) Lack of a sufficient number of technical personnel with ample practical experience behind them to enable them to do the work effectively or to present it in such a manner as to command the attention and arouse the interest of the people for whose benefit such work is primarily intended. The employees of this Division are young men who, in most cases, are graduates

from the College of Agriculture, University of the Philippines, and the Central Luzon Agricultural School, but *as yet* not all of them possess that personality, tactfulness, maturity of judgment, and experience necessary to efficiently perform the duties devolving upon them. Some are too young. It is felt, however, that, as they gain further experience in their work, as they learn to distinguish between essentials and non-essentials, as they come in contact more and more with people, and as their activities are given stricter supervision, as it is proposed hereafter, their collegiate training will be, in the course of time, complemented with such qualifications as will make their services really valuable to the Government.

(2) Natural suspiciousness and prejudice old farmers feel towards young men to possess superior knowledge in agriculture. Care was usually taken, in this connection, to recommend to the farmer only *tried* practices and well tested seeds.

(3) The prevalent system in the Philippines where large landowners rent their lands to other people on crop shares. In this case, it is not always an easy matter to induce a mere tenant to change his methods; besides his concealed objection to any interference with his customary ways, he fears the opposition which such change might provoke on the part of the landowner. On the other hand, the latter is generally indifferent to the teaching of a representative of this Division or this Bureau. Tact and persistent efforts on the part of such representative, and actual demonstration of the advantages which may be derived from the application of such teaching are necessary to overcome this obstacle. The development of farm ownership in the Islands in the hands of an educated class will tend to remove this difficulty gradually.

(4) The one-crop system is so well established a phase of Philippine agriculture and the ignorance, or lack of proper appreciation, on the part of soil tillers of the advantages of crop rotation so widespread, that generally it has been found difficult to induce secondary crops. Furthermore, the simplicity of the average Filipino Farmer's diet accounts for the difficulty in making the practice of growing secondary crops more common. There is need of a systematic educational campaign to convince rural residents, and make them appreciative, of the value of an abundant supply, and a variety of nutritious food.

(5) The condition of the rice fields and the character of animal power found on the great majority of them do not permit the cultivation of the land with such improved implements as are usually found on an up-to-date farm. The work of the

(*a*) A coöperative demonstration plot

(*b*) A corner of the demonstration plot at Santa Cruz, Laguna

Zambales variety with a disease. Polo, Bulacan

Zambales variety affected with a disease. Polo, Bulacan

agents of this Division, in this connection, should be confined to the introduction of only such methods as, under existing conditions, the rice growers are prepared for or could readily apply.

(6) Lack of irrigation systems to supply the water necessary to insure crops. The policy of the Government looking forward to the establishment of irrigation systems in as many parts of the Islands as possible will solve this problem in the course of time.

(7) Typhoons, floods, drought, and locusts which time and again destroy Philippine crops.

(8) Lack, in many cases, of proper support from the provincial and municipal officials and the leading inhabitants of the communities.

(9) The lack of a fixed fund to meet the expenses necessary in maintaining the operation on provincial and municipal nurseries. Hereafter the establishment of provincial and municipal nurseries should be encouraged only when the province or municipality concerned is really interested and is in a position to provide the necessary funds.

RECOMMENDATIONS

There being as yet so much to be done to insure that the activities of this Division shall bear more visible results, or to make them serve the purpose for which they are undertaken, it is deemed advisable to continue them as they are for some time longer, only making in them such changes as are demanded by the circumstances.

Coöperation among farmers is a subject which farm advisers and agricultural assistants should stimulate more. Strong efforts should be made in conjunction with those of the Philippine Chamber of Agriculture for the realization of the proposed plan of the latter to establish provincial and municipal chambers of agriculture. Through these chambers, if formed by the right kind of people, community interest may be better expressed and community needs may be better learned. Through them, community initiative and leadership will manifest themselves and coöperative or united action can be secured on whatever task planned and undertaken for the welfare of the community.

This Division should concern itself also with studying and developing simple coöperative systems of buying and marketing to enable farmers to buy their supplies collectively or to place their products in the market with the least possible intervention of middle men.

Farm advisers and agricultural assistants should look for every opportunity to coöperate with the boys' and girls' clubs organized by the schools. Some definite understanding ought, it seems, to be had with the Bureau of Education on this matter.

PLANT PESTS CONTROL DIVISION

ACTIVITIES

(*a*) Eradication of plant pests and diseases (locusts, rats, bud-rot, and abaca, coconut, rice and miscellaneous pests and diseases)
(*b*) Plant quarantine service
(*c*) Research work

PERSONNEL

1 Chief of division.
1 Supervising plant inspector.
1 Assistant plant pathologist.
1 Entomological preparator.
2 Plant inspectors.
6 Assistant plant inspectors.
3 Junior plant inspectors.
1 Clerk-stenographer.
1 Assistant clerk.
1 Draftsman.
13 Laborers.

LOCUST EXTERMINATION

The locust infestation this year has gradually increased from twenty towns during the month of March to ninety towns between the middle of July and August, 1921, and by the end of the year there were fifty-eight towns infested. The reasons for such increase of infestation are: first small number of people living in places where such infestations occur; second, infestations mostly originated from cogonal regions far from the reach of people and then swarmed to other places or islands; and third, the great distance between barrios, especially in the southern islands where the barrios are from 30 to 40 kilometers apart, and consequently, the few people in an infested barrio cannot cope with the work. It is impracticable to send people from one barrio to another to help the infested barrio due to lack of transportation facilities and subsistence. Take, for example, a barrio about 30 kilometers from other communities. People from such communities journeying to an infested barrio would spend more than a day on foot. The amount of 15 centavos authorized for a meal is not sufficient

for three meals, and if we increase this amount of 15 centavos, there will be no funds to cover the sum spent for such allowance. Consequently, in trying to carry on locust campaigns, there are places where you cannot enforce the provisions of the Locust Act No. 2472. The law was framed to meet conditions in the thickly populated regions of Luzon, but when it comes to some of the Visayan Islands and Mindanao, the strict enforcement of the law would mean arrant tyrannizing over the people, inasmuch as we cannot even give them food for three meals a day.

The use of white arsenic, mixed with rice bran and other substances, such as lemons and molasses, was started in the Province of Bohol, but the results have not yet been reported. If satisfactory, this office might purchase chemicals and the other necessary materials and prepare the poison to be distributed to infested provinces, through our supervising locust inspectors.

The amount of ₱6,500 was allotted as Insular aid to infested provinces from the "Contributions and Gratuities Funds" of the Bureau, as follows:

Lanao	₱2,000.00
Bukidnon	1,000.00
Iloilo	1,000.00
Cebu	1,000.00
Leyte	500.00
Misamis	500.00
Tayabas	500.00
Total	6,500.00

Due to the fact that the "Contributions and Gratuities Funds" of the Bureau were exhausted about the middle of the year, it was deemed necessary to request the transfer of funds from non-infested to infested provinces, which materially aided in supressing the march of the pests, as follows: From Batangas to Bukidnon, ₱990.22; from Cagayan and Rizal (₱500 each), to Bukidnon, ₱1,000; Mountain Province to Iloilo, ₱400; Pampanga to Misamis, ₱500; Bohol to Camarines Sur, ₱500; Nueva Ecija to Lanao, ₱300; Zambales to Lanao, ₱500; Sorsogon to Masbate, ₱500; Davao to Masbate, ₱500; and Nueva Vizcaya to Leyte, ₱400.

RAT EXTERMINATION

The rat campaign work this year was transferred from our inspectors to the farmers themselves. Our inspectors only gave instructions as to the best methods of combating them in the field by demonstration and instructions which were distrib-

uted by this office in Spanish and English. During the year, this office distributed 701 kilos of white arsenic and some carbon bisulphide in connection with this campaign, gratis to the farmers, municipal and provincial authorities, who requested the poison in the form of letters and resolutions, and personal requests.

Where an infestation has been severe, our inspectors were sent to the place and they distributed poison or personally supervised the work of killing rats or actually doing the work of extermination.

Acting upon the recommendation of this office, the Provincial Board of Camarines Sur has adopted a resolution to the effect that, in order to make the killing of rats more effective, a committee of three (composing the municipal president, the municipal treasurer, and the municipal chief of police) has been authorized in each municipality of the province to purchase field rats at the rate of 2 centavos each. Dead rats after purchase are to be mutilated or buried. The amount to be paid will come from the gratuitous funds allotted by this Bureau to the Province of Camarines Sur, or from any other sum especially appropriated for the extermination of agricultural pests by the province itself.

ABACA DISEASES' EXPERIMENTS

Physiological experiments were conducted in Silang, Cavite, to find out the cause of abaca heart-rot and root-rot diseases, and to determine the most practical way of controlling these diseases.

Experiments were conducted along the following lines:

(*a*) Different varieties (32 in all) were planted, where many of the abaca plants had died. Seeds were obtained from La Carlota Experiment Station and from the diseased plantation of Silang, Cavite.

(*b*) Different fertilizers were applied, as it was believed that the cause of the diseases might be due to certain soil toxics, or soil acidity.

As a result of these experiments, the following conclusions have been drawn;

(1) Disease-resistant plants can be developed from seeds of different varieties.

(2) Different varieties show different degrees of resistance to the disease.

(3) Scattered seedlings in abandoned diseased plantations are becoming resistant plants.

The belief that the acidity of the soil is the cause of the diseases proved to be true as the rapidity of the rate of growth of the disease in relation to the degree of the alkalinity of the fertilizers used, i. e., the combination of ash, lime, and sodium nitrate, induced the most rapid growth, while the ammonium sulphate, which is the acidic fertilizer, induced the slowest growth.

COCONUT PESTS AND DISEASES

The work of inspection and destruction of coconut trees attacked by the worst enemy of the coconut, the "bud-rot" was discontinued about the middle of the year due to lack of funds. As a result of the campaigns against this coconut disease, 3,584,222 trees were inspected in the Provinces of Tayabas, Laguna, Pangasinan, Iloilo, Cavite, Camarines Sur, and Zamboanga. Of these, 2,697 trees were found to be infected and were cut down and burnt by our inspectors, with the coöperation of the coconut grove owners, to prevent their trees from being infected with the disease.

There are minor coconut pests which have done slight damages to coconut trees. One of them is the coconut leaf miner, *Promecotheca cumingii* which has been reported from Misamis, Lanao, Cotabato, Laguna, and Zamboanga. However, it disappeared as the eggs, larvae, and pupae were well parasitized.

Another coconut pest known as the slug caterpillar *Thosea cinereamarginata* broke out in the Provinces of Lanao, Cotabato, and Zamboanga. The infestation, however, was controlled by three species of hymenopterous insects and one dipterous insect which parasitized the larva of this slug caterpillar.

PLANT INSPECTION SERVICE

The plant inspection service is the biggest and most important project of this Division. In the Philippines we have already experienced great losses due to the importation of plant pests and diseases. A tremendous loss will be experienced if the continuous influx of plant pests and diseases is allowed. This country has already quite a number of foreign pests and diseases. For lack of statistical data, these cannot be given out just now.

One dangerous pest, which, if introduced, would become a menace to our horticultural products, is the so-called San Jose scale (*Aspidiotus perniciosus* Comst.), which has caused much damage in Japan and in the United States and elsewhere. For

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this reason we are inspecting fruits from other countries as well as for the San Jose scale and other scale, dipterous and lepidopterous insects. We already intercepted the San Jose scale insect from the importation of brown pears coming from Kobe, Japan. These fruits were all fumigated with potassium cyanide and carefully scrutinized to see that the insects were all dead.

Where a foreign plant disease has already gained a foothold in the Philippines, administrative orders have been issued and inter-provincial quarantine has been ordered by the Director of Agriculture, through the recommendation of the Plant Quarantine Board.

We have increased the number of ports of inspection from one to four, namely, Manila, Cebu, Iloilo, and Zamboanga.

To show roughly the volume of work accomplished by the plant inspection service, the following tabulations are herewith given:

Vessels inspected	481
Passengers arrived from fruit fly infested countries	1,966
Passengers found carrying plant materials	3,119
Manifested cargoes:	Parcel.
Passed as free from pests and diseases	429,711.5
Fumigated	1,668
Washed with hot water	12
Selected or partly destroyed	978
Refused admittance	.....
Contraband destroyed	442
Total horticultural manifested imports	432,811.5
Found carried with baggage:	
Passed as free from pests and diseases	32,797
Fumigated	241
Selected or partly destroyed	828
Contraband destroyed	380
Total horticultural imports found with baggages	30,246
Inspected in the post-offices:	
Passed as free from pests and diseases	1,070
Fumigated	7
Refused admittance	1
Total horticultural imports by mail	1,078
Grand total horticultural imports into the Philippines during 1921	466,375.5

One hundred twenty-six (126) plant pests and diseases were intercepted from the above imported plant materials, a great number of which were not yet found in the Philippines.

During the year 162 certificates have been issued at the port of Manila covering the following exported plant materials: 4,606 living plants, 515 cuttings, 257 packages of seeds, and 109 coconuts.

At the port of Cebu, three certificates were issued for 2 coconuts and 3 baskets of mango fruits.

At the port of Iloilo, two parcels of plant materials were certified for exportation.

At Zamboanga, 1,102 parcels of plant materials were certified for exportation.

ENTOMOLOGICAL SPECIMENS

Entomological specimens identified during the year	94
Entomological specimens classified according to order and family	130
Entomological specimens bred and are being bred	45
Entomological specimens collected and bred, which were mounted and spread	600
Entomological specimens in Riker mounts containing short biological description	23

MISCELLANEOUS PESTS

Several pests and diseases were reported this year. The most widely prevalent pests reported during the year were the two species of rice cut-worms (*Prudenia litura* and *Spodoptera mauritia*). Reports were received from La Union, Camarines Sur, Sorsogon, Batangas, Tayabas, Bataan, Pampanga, and Mindanao. Inspectors were dispatched to show the best ways to get rid of the pests by giving instructions and holding meetings with the townspeople, explaining to them the best method of controlling these pests.

Another rice pest reported during the year was the rice bug, locally known as "atangia" (*Leptocorisa acuta*). Circulars containing instructions as to the best method of combating this pest were distributed to the farmers concerned.

PLANT DISEASES LABORATORIES

The work on plant diseases has been continued as last year. Mr. Mariano Medalla, Assistant Plant Pathologist, has been specializing on sugar cane, devoting most of his time to the Fiji disease and downy mildew of sugar cane.

Other diseases of sugar cane known in this country are, according to the Plant Disease Laboratories, as follows: Pineapple disease, mosaic disease, yellow stripe disease, top rot, *Helminthosporium* spot, *Pestalozzia* spot, red rot leaf killing disease, soleratial banded disease, red vascular disease, "pokkah bong," red spot, smut, rust, *Merasmius* root disease, sheath spot, *Phylla-*

chora spot, *Sclerotium* disease, and sooty mold. Of the diseases mentioned, the first 15 have been determined by the Plant Diseases Laboratories of the Bureau of Science, and their presence is claimed by the Mycologist of that Bureau to have been first observed in the Philippines by them. This is the first and biggest plant disease survey of sugar cane ever made in the Philippines.

The work on diseases of the abaca plant has been done by Mr. F. B. Serrano, assistant plant inspector, under the guidance of the mycologist, Mr. Lee. Investigations of the abaca heart-rot, and the deterioration of hemp have been carried on. The causal organism of heart-rot has been isolated and its pathogenicity has been demonstrated by inoculation tests.

In the case of deterioration of low grade abaca much has been accomplished, although there is still much to be worked out. The problem was taken up by considering each of the theories advanced by the London buyers and definitely proving or disproving each hypothesis. Coöperation in this problem with the Fiber Division was of great value in this work.

According to Mr. Lee, the theory was advanced by Sir David Prain, Director of the Kew Gardens in London, that the deterioration of the fiber was due to the action of micro-organisms on the fiber. Through investigations made by our men at the laboratory, this was proved and it was found possible to isolate from deteriorated hemp 22 micro-organisms.

Mr. F. M. Clara, assistant plant inspector, has been detailed to study the tobacco diseases. This work has been carried on by him to try various tobacco varieties to determine their resistance to some of the serious diseases.

In the laboratories, plant diseases from the field and intercepted plant materials from foreign countries are examined and determined by our men, under the guidance of the mycologist of the Bureau of Science, who gives recommendations as to the proper control measures.

RECOMMENDATIONS

1. It is recommended that three or four experienced men be employed as temporary locust inspectors, whose duties shall be to go about and see that the provisions of the Locust Law are enforced and to conduct organization campaigns, especially in the infested provinces. This organization work was done by this office in 1917 in the Provinces of Nueva Ecija, Tarlac, and Pangasinan and the results were highly satisfactory.

2. It is also recommended that afforestation be pushed to control the locusts.

PLATE VII

Zambales cane variety affected with an unidentified disease. Polo, Bulacan

PLATE VIII

Maguindanao variety of abaca (Manila hemp)

3. The value of plant inspection and plant quarantine work has been emphasized many times. For this reason, it is strongly recommended that plant inspection houses similar to that built in front of Pier 5 be constructed at the ports of Cebu, Iloilo, and Zamboanga, and, if possible, at Jolo. A piece of land should be acquired by this Bureau for isolation purposes in the ports of Manila and Zamboanga.

4. Frequently plant quarantine inspectors of this division detailed at the port of Manila work overtime without any extra compensation, sometimes until 10 o'clock at night and whole Sundays and holidays due to arrivals of big consignments of fresh fruits and other plant materials. The importers or interested persons want the inspection work expedited and are willing to pay the men so they may remove the consignment from the Custom House or the piers as soon as possible. The inspectors oblige them without accepting their offers of payment as there is no provision in the law allowing them to do so. In view of the above, it is recommended that the plant quarantine inspectors at the port of the Manila be given the same privileges to receive compensation as are given to the employees of the Bureau of Customs for working overtime.

It is hoped that the Federal Government—which was already asked—will aid the Philippine Government by having the army help us exterminate the locusts by the use of poisonous gas.

FIBER DIVISION

ACTIVITIES

(*a*) Fiber inspection.
(*b*) Fiber plant investigation.
(*c*) Propaganda work among the planters.

PERSONNEL

During the fiscal year covered by this report, the personnel of the fiber division consisted of one chief, one assistant chief, eight supervising fiber inspectors, sixteen fiber inspectors, twenty-five assistant fiber inspectors, two assistant agronomists, two agricultural assistants, six clerks, and several laborers.

FIBER GRADING AND INSPECTION

The enforcement of the fiber grading and inspection as contemplated by Act No. 2380 constituted the most important function of the fiber division during the year.

It was in connection with the enforcement of the fiber grading and inspection law that the fiber division received several complaints from London. As early as the latter part of 1919 this

office began to receive some complaints from London regarding alleged defective quality of abaca being received from the Philippines, but it was not until the year 1920 that the complaints became sufficiently important to require attention.

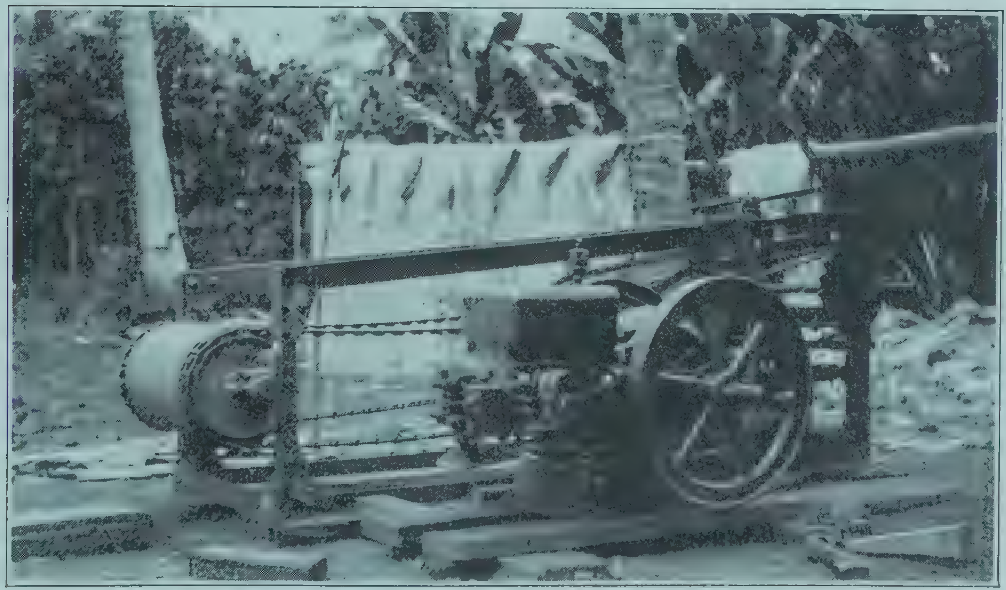
The cause of the complaints seems to rest mainly on the depressed condition of the fiber market in Europe as a result of the world war. At the beginning some of the complaints alleged inefficiency of the Government to carry on proper inspection of the fiber, but later the complaints dealt with the real or imaginary deterioration of the fiber due to causes as numerous and as varied as the many theories presented by the London importers. In some cases the complaints were reasonable, as for example, when the fiber received by the importers had been in storage for a long time before exportation. It is an undeniable fact that abaca fiber long held in storage deteriorates in strength and color, and the lower the grade, the quicker is the deterioration in strength.

Another ground for complaint is the admixture of Canton and Pacol with abaca of the lower grades. Canton and Pacol fibers are far inferior in strength to abaca fiber and their admixture with the latter is prohibited by law. Being weak fibers they cannot be stripped in the fine grades and therefore cannot be mixed with abaca of the finer grades. But the case is very different when the same weak fibers are mixed with low grade abaca where it is extremely difficult, if not impossible, to detect the adulteration due to the similarity in color and cleaning to low grade abaca.

To put a stop to this adulteration of abaca and to protect the interests of the foreign importer, and also at the same time to curtail production to enhance the price of fiber in these Islands, this office recommended the adoption of Administrative Order No. 13 on April 28, 1921, which eliminates the production of low grades of abaca fiber. This order was originally recommended to take effect on June 1, 1921, but it was not approved by the Department Secretary until July 20, 1921, and it became effective September 1, 1921. In connection with this Administrative Order it might be of interest to note that the net stocks of baled abaca fiber at Manila and Cebu were reduced some 130,000 bales after the Order had been in effect four months, and at the same time an increase in quotations of from three to four pesos per picul was noted.

With regard to the classification and baling of fibers in the grading establishments, the work was carried on during the year with very little friction, if any at all, except in one case which occurred on or about August 15, in Legaspi, Albay, where

(*a*) Beierly-Gohn hemp machine



(*b*) Stewart stripping machine

Transporting abaca

the agent of a large fiber exporting firm in Manila began to grade fiber of the U. S. grades at a certain per cent above standard grade prescribed by law, and to use certain marks which were not authorized by the Government on their bales of fiber. The case was brought to the judicial authorities by the chief of the fiber division. The prosecution was discontinued, however, upon promise in writing of the manager of the firm in question to conform to the official standards in the future.

GRADING STATIONS AND ESTABLISHMENTS

During the past year 125 fiber grading establishments were granted permits as prescribed by Act No. 2380, to classify and bale fibers according to the Government regulations.

ABACA INVESTIGATIONS

Due to the much discussed Order No. 13 and the many complaints against the quality of abaca fiber that reached London in 1920–21 to say nothing of the many changes in our personnel our attention was mostly confined to the testing of tensile strength of the different grades of abaca fiber under various conditions. We narrowed our experimenting to this much believing that the cause of the deterioration of abaca fiber lies largely in the long storage of fiber both in the Philippines and abroad while waiting for a better market.

Condition of abaca at La Carlota Experiment Station.—The abaca plants occupy seven separate fields. This year proves once more that the climatic conditions in La Carlota are by no means favorable to abaca culture. The plants suffered much from drought and are stunted in their growth. This ought to be an argument for the necessary appropriations, so that the abaca trial plots asked for as early as 1919 could be established.

From January to July 1921 the total number of abaca stalks raised and stripped from fields were 222.

Cotton at La Carlota Experiment Station.—Fourteen varieties of cotton are under observation at this station. The most productive varieties were found after harvesting to be Kinachila, Meade and Caravonica.

The most common enemies of the cotton plants found were scale insects and the *Dysdereus cingulatus*, which attack both the leaves and bolls. Each and all of the varieties are attacked by these insects.

Of the five varieties of cotton tested at the same time it was found that seeds germinate three days after planting; that flowers appear in from 74 to 93 days and bolls form two days after the opening of the flowers.

Agave.—The group comprises sisal and maguey, henequen, zapupe and agave sp. All of them were reported by Mr. A. H. Lee, Mycologist, Bureau of Science, in June 1921, to be badly infected with anthracnose disease. Subsequently the Superintendent of La Carlota was instructed to observe a strict quarantine of the affected plants to prevent the spread of anthracnose.

On July 22, 1921, the Superintendent reported that sisal and henequen were not affected by anthracnose; maguey was slightly affected while zapupe was badly attacked. The trimming and burning of diseased parts and whole plants as well as the spraying with lime-sulphur solution were accomplished. On October 7, 1921, he reported again that the infection continued to spread in spite of the spraying and the sanitary measures observed. Consequently he ordered the attacked plants to be dug up and thrown to the river.

Kapok (*Ceiba pentandra*).—The kapok trees under observation are of two groups: those grown from seeds and those from cuttings. Judged from the number of pods yielded by each tree, those grown from cuttings are more productive. As to longevity, nothing is as yet certain. Trees of both groups are doing well. Bats are injurious to green pods. The harvesting of ripe pods begins from March and lasts till June.

There are three rows of *Bombax camiguinensis*, seventeen plants in all planted a distance of 6 x 6 meters at this station. They are growing well.

MISCELLANEOUS

Sansevieria.—Three species of this liliaceous plant are cultivated at La Carlota Experiment Station. They are *S. guineensis*, *S. sulcata* and *S. Zeylanica*. *S. sulcata* has the longest leaves measuring 114 centimeters, *S. guineensis*, 95 centimeters, and *S. Zeylanica*, 60 centimeters.

Pineapple (*Ananas comosus*), *etc.*—Pineapple (Ananas comosus); Roselle (Hibiscus sabdariffa); Ambari hemp (Hibiscus cannabinus); Anabo (Abroma augusta); Ramie (Boemeria nivea); Indian jute (Corchorus olitorious) are all growing well. Roselle fiber has a good outlook for paper manufacture according to a large manufactuding firm in Boston, the Hollingsworth & Vose Co., and accordingly a 5-kilo sample of roselle fiber was sent as per their request for experimental purposes.

The Panama hat palm (Carludovica palmata) grows best under shade of ipil-ipil and bamboo. The exposed plants are stunted in their growth.

DISTRIBUTION OF FIBER PLANTING MATERIALS

During the year there were distributed the following planting materials:

	Seeds (grams)	Suckers
Abaca	3,105	
Cotton	4,685	
Jute	50	
Kapok	37,110	
Roselle	4,850	
Phormium tenax	60	
Maguey	....	10,010
Panama hat palm	....	250
Sisal	....	10,000
Total	49,860	20,060

Whether abaca (Musa textilis) will remain or not a natural Philippine monopoly, if no prohibitive measure is enacted, only time can tell. Already several countries have introduced abaca into their respective tropical colonies. Foremost among these are the Dutch East Indies, which are now exporting abaca in commercial quantities although it is inferior to Philippine abaca in strength, according to the report made by Mr. Bartolome following his investigation in 1920 in Java and Sumatra.

Mr. Camus of this Bureau, on his return from London, where he attended the Exposition in June 1921, reported that he saw abaca fiber from plants grown in British North Borneo and Formosa. The French introduced abaca in Angiers, France, French Indo-China, and in Tahiti; the British in British North Borneo, Straits Settlements, Federated Malay States, Lower Burma, the Bahamas, the Seychelles, Australia, and British East Africa; and the Japanese have plantations in Davao and in Formosa. Costa Rica, Nicaragua, and Ecuador are also experimenting on abaca cultivation; so also the National Educational Association of China at Shanghai. And lastly the United States Department of Agriculture has asked for abaca suckers to be planted in Panama.

Whether there will develop at some future time an abaca fiber industry in some other country that would be a serious competitor to the Philippine Islands, only the future can determine. However, it is strongly recommended to the Philippine fiber producers that their abaca fiber be prepared to meet the most critical demand of the consumer by being free from tow, and strippy fiber, by having the fiber uniform in each hank in both color and stripping and the hanks uniform in size.

In most cases, competition of a serious nature in any industry is a result of faulty preparation of the article for market. Pleasing the consumer, in a great measure, offsets probable competition. The statement is often made that "abacá fiber has no equal in the hard vegetable fiber world." This statement is true only when abaca fiber is properly prepared, viz, by being stripped free from pulp and properly handled so as not to become damaged before it is baled for exportation.

The only serious complaints that have been registered against abaca fiber by foreign consumers, has been registered against the defective method of preparing the fiber for exportation. The reputation of abaca fiber in the consuming markets is wholly in the hands of the abaca fiber producers. Without their coöperation in properly cleaning and preparing their fiber for the market, the Government is powerless in sustaining the reputation and commercial value of our fiber in foreign markets.

The Government has from time to time, during the previous eight years, since the Fiber Grading Law had been in operation, carried on extensive campaigns in the abaca producing provinces with a view of improving the methods of stripping, thereby improving the quality of the fiber produced and insuring the producers a better financial return for the amount of labor involved.

Other activities.—In response to the invitation sent to the Philippine Government by the London authorities to participate in the "London Exhibition of Rubber, other tropical products and allied industries" which was held on June 3 to 17, inclusive, 1921, the Bureau of Agriculture sent in the latter part of March, 1921, a large collection of exhibits among which was a fiber exhibit prepared by this section. These fiber exhibits were given the 1st award (gold medal) in fiber competition.

RECOMMENDATIONS

The importance and urgency of the establishment of abaca trial plots in at least four abaca districts, for example, Cavite, Albay, Leyte, and Davao, cannot be overemphasized. Whatever results we might obtain from one place cannot be applied exactly in another. The best varieties that were found in one place are not necessarily the best also in other places, as our experience shows. Hence the urgent necessity of abaca plots in each of the abaca districts.

ANIMAL INSURANCE DIVISION

ACTIVITIES

(*a*) Enforcement of the Draft Animals Insurance Law.

PERSONNEL

There was a slight decrease of the personnel of the Division from last year on account of separation and resignation. On December 31, 1921, it consisted of one chief, one assistant chief, two supervising agents, one investigator and accountant at the same time, one law clerk, one stenographer, 16 agents, 21 assistant agents, and 6 clerks two of whom are permanent and the others are temporary.

INSURANCE BOARD

The Insurance Board is composed of the Director of Agriculture as chairman and two private individuals, Messrs. Matias Gonzales and Emeterio M. Sempio as members. The Board is responsible for the direction and administration of the operation and affairs of the work Animals Insurance Society according to law. The members have been rendering their services willingly and faithfully in spite of the meager per diems given them. The Board has solved with the fairness and impartiality all the questions which were brought before it.

MEMBERSHIP

During the two and one-half years that the Work Animals Insurance Society has been in operation, there have been registered 3,888 members; 915 members were registered in the last half of 1919; 1,830 in 1920, and 1,142 in 1921. There was a slight decrease of 688 members registered this year as compared with last year, not on account of the unwillingness of the farmers to insure their work animals but due to the monetary crisis felt throughout the country as a result of the economic readjustments of the world.

NUMBER OF ANIMALS INSURED

During this year there are 4,371 head of animals duly insured and since the Draft Animals Insurance Law became effective there have been 8,714 head insured; 1,682 policies have expired and not been renewed and there were 426 policies on which the indemnity was paid, 11 were denied payment and 19 cases still pending for approval, thus the total of deaths was 516. According to the foregoing figures there are therefore 6,516 head of insured animals for which the Work Animals Society is still held responsible.

OPERATION OF THE INSURANCE

During the last half of 1920, the society collected ₱34,125.35 as premiums and paid the amount of ₱6,717.50 as indemnity to policies, showing a balance in favor of the society amounting

to ₱27,407.85. Fifty per cent of the balance, according to the law, should revert to the reserve funds of the society and the other 50 per cent be declared as dividend by the Insurance Board. If a dividend is declared, there will be an approximate rate of 40 per cent.

During this year the appearance of rinderpest in the provinces of Capiz, Laguna, and Iloilo, where there are many animals insured, coupled with the monetary crisis effected a decrease in our collection of premiums as compared with those for 1920. The total collection of premiums during the year was ₱48,093.37 against the amount of ₱56,937.97 paid as indemnity on policies. Apparently there is a loss of ₱8,880.60, but this loss can easily be covered up by the gain of ₱13,703.92 obtained last year, leaving still a marginal gain of ₱2,411.66 to be added to the yet untouched ₱25,000 appropriated as the initial working fund of the society. There is, too a bright prospect during the coming year due to the fact that there are signs of the return of normal conditions in the economic world and also rinderpest is now being controlled successfully.

With regard to the collection of entrance fees, the society has collected ₱5,299 available for administration purposes. With this amount and the amount of ₱5,000 allotted for the same purpose, we have ₱10,299. Disbursements in this item amount to ₱6,728.37, leaving a balance of ₱3,570.63 still available for expenditure.

In view of the above, there is still a total amount of ₱47,089.68 including the initial working fund available to meet all possible obligations of the associations.

CONCLUSION

The mutual insurance for draft animals is proving itself to be of great benefit and aid to the farmers of the country. The insurance society has distributed ₱63,691.47 as indemnities to the owners of 426 policies of insured animals; the members and owners of insured animals have been afforded on account of the insurance more facilities in securing credits or loans from rural credit associations and provincial branches of the Philippine National Bank, as they can give their policies as security. That is only the material side of the aims for which the law creating the insurance was enacted, but one of the most far reaching results of the campaign for the mutual insurance of work animals is the instilling into the minds of the farmers of the spirit of organized coöperation to the end that self-reliance be developed among them.

It would not be amiss to add that the task is expensive at the beginning as every enterprise of its kind, but the undersigned is of the belief that the benefits which will accrue to the farming class will compensate the Government for the trouble of pushing the work already begun. The lack of working animals and sufficient capital are the greatest handicaps of our small farmers and the absence of either one causes the ruin of a farmer. But through the medium of coöperative insurance and coöperative rural credit a farmer can overcome these difficulties.

RURAL CREDIT DIVISION

ACTIVITIES

(*a*) Organizing, supervising, and examining rural credit associations.

(*b*) Helping farmers to obtain loans from banks.

(*c*) Fighting the usury.

(*d*) Propaganda work on coöperative activities.

PERSONNEL

There have been sixteen agents employed during 1921, each has a district and every effort has been made by them to create greater interest among the members to increase the capital and to develop a greater spirit of self-dependence and better management.

SCOPE OF WORK

The work of this Division has been mainly that of organizing and supervising associations for accumulating funds and making small loans from these to members for "exclusively agricultural purposes," which is the only activity permitted under Act No. 2508 as amended by Act No. 2566.

On December 31, 1921, there were 537 associations incorporated with a paid-in capital of over one million pesos and another ₱200,000 in deposits, and another one million loaned to associations under Act No. 2818 which is managed by the Secretary of Agriculture and Natural Resources. The Philippine National Bank has recently made ₱500,000 available to associations for six-month crop loans of ₱2,000 each for such associations as meet its conditions. On January, 1921, twelve associations had received loans and a number of others are in preparation.

Ten of the associations have a paid-in capital of ₱10,000, which is the limit allowed by Act No. 2508. They desire to increase their capital, so a bill has been presented to the Legislature in session (H. R. Bill No. 750) to permit the capital to be increased to ₱20,000 and a number of minor changes have been

asked for in the present law, that have been found necessary during the five years of work.

The complete statistics of the associations for 1921 will not be available until all the treasurers send in their returns, but from those already received and from the inspection reports of the agents of those associations visited by them, it is noticed that there has been an increase in the capital and progress of all the associations.

It will be noted that nearly two and one-half million pesos are loaned out in these associations, the first one of which was incorporated October 16, 1916. The main effort will be to urge each association to increase its paid-in capital and to secure more deposits; to organize as many of the remaining 300 municipalities as are yet unorganized and to improve the internal working by teaching the principles of coöperation to the 70,500 share-holders, many of whom have bought shares and entrusted the management to the directors without knowing much about the theory or practice of the association.

The Government will continue to provide a supervising staff to prevent apathy, serious mismanagement or loss to shareholders. But in no sense should there be any move to make these coöperative associations governmental in the sense of directly managing them or providing the funds. The benefit to these associations of Government supervision will be the increase of confidence of the depositors and shareholders in their safe administration and prevention of fraud, and the prudent advice and encouragement by agents who will keep them solve their difficulties. The benefit to the Government will be the broadcast education of the people in simple banking methods by practical demonstration.

FARM STATISTICS DIVISION

ACTIVITIES

(*a*) Gathering agricultural information—livestock, 40 crops, rural economics, farm labor, etc.

(*b*) Preparing and publishing agricultural and economic statistics.

(*c*) Forecasting crop production.

PERSONNEL

The year opened with a working force of thirty-six permanent employees (including two who were holding positions loaned from the Administrative Division) and ten temporary employees, making a total of forty-six.

During the year, twenty-two new appointments were made and thirty-two employees were dropped either by resignation,

transfer or by reduction of force, thus bringing down the total number of personnel to 36 at the end of the year.

ROUTINE WORK

This was of the same nature as last year but there was a big increase in the amount.

It was during that period of expansion that this division realized the narrow limits of its field of action and began to extend its activities. More efficient methods of gathering data were adopted, all blank forms were revised and additional ones prepared so that the original number of nine crops on which statistics were compiled was increased to forty. Moreover, better methods of compilations were devised and all data carefully analyzed to detect omissions and correct errors or to prevent their commission. All these innovations increased the amount of clerical and technical work and naturally required more funds and personnel.

During the year just ended, the Division of Farm Statistics answered a considerable number of requests received from Commercial houses, chambers of commerce, colleges, government institutions, and received many laudatory letters for the work done, while the agricultural statistics and graphic maps have been quoted and published in several standard magazines. The opening of the Legislature brought the busiest period of this division, as numbers of bills bearing on agricultural subjects were submitted this year and this division was called upon to furnish information and help. In fact, the statistics of this division were the chief arguments in the discussion and approval of the rice tariff bill.

RECOMMENDATIONS

1. That in the coming appropriations sufficient funds be given the Division of Farm Statistics to enable it to appoint technical employees in different parts of the Islands to conduct statistical work concerning farm accounts, labor, and marketing methods for agricultural products.

2. That sufficient funds be given this division to employ clerks in the provincial treasury offices to copy all declarations of land and registrations of animals in order to check the work of this division.

ANIMAL HUSBANDRY DIVISION

ACTIVITIES

(*a*) Feeds and feeding experiments.
(*b*) Animal breeding; experimental.
(*c*) Selection, multiplication, and distribution of livestock.
(*d*) Purchase and sale of animals.

ADMINISTRATION

The activities of the Animal Husbandry Division were practically the same as in the preceding year in spite of the financial depression which reigned during 1921. While to some extent this division had to curtail some of the work on certain projects, limit its expenses, its supplies and materials, and even reduce its force in the field, the public breeding service was not greatly affected. There were 2,358 services rendered by the Bureau's sires and the births during the year numbered 3,014, the offspring being worth about ₱103,550. These results are slightly less than those of last year due mainly to the fact that in 1921 there were only 99 sires while in 1920 there were 128.

The increasing interest in animal husbandry increased the number of inquiries and the written and verbal replies thereto made by the Division during the year greatly as compared with 1920. The activities during 1921 were carried on under twelve functional accounts, as follows:

1-G Divisional Administration.
2-G Alabang Stock Farm.
3-G La Carlota Experiment Station.
4-G Cebu Breeding Station.
5-G Batangas Breeding Station.
6-G Dingle Poultry-Swine Station.
7-G Balayan Poultry-Swine Station.
8-G Naic Poultry-Swine Station.
9-G Tiaong Poultry-Swine Station.
10-G Oriental Negros Breeding Station.
11-G Bayombong Cattle Breeding Station.
12-G Other Stations.

There were purchased from the United States during the year for the purpose of introducing new blood to upgrade the native stock, of testing their adaptability, and for sale and for experimental purposes:

95 Berkshire pigs	₱22,365.45
3 Stallions	6,000.00
16 Bronze turkeys	820.00
14 Toulouse geese	560.00
14 Embden geese	560.00
Total	30,305.45

The Division began the year with 14 poultry-swine stations doing more or less extensive breeding work in different parts of the Islands. Three of these stations were maintained entirely from Insular funds, but later on another, that at San Antonio,

Zambales, was added to this list due to the shortage of local funds, while that at Naic, Cavite, had to be closed for the same reason. One station, that at Cabanatuan, Nueva Ecija, was finally sold to the Province with all the animals for ₱495.68. Three new coöperative stations, however, were opened in the meanwhile, so that at the close of the year there were also 13 poultry-swine stations located as follows:

COÖPERATIVE STATIONS

Naic, Cavite.
Santa Barbara, Pangasinan.
Palo, Leyte.
Bayombong, Nueva Vizcaya.
Bilar, Bohol.
Amulung, Cagayan.
Vigan, Ilocos Sur.
Los Baños, Laguna.
San Jose, Antique.
Ilagan, Isabela.

STATIONS MAINTAINED BY THE BUREAU

Tiaong, Tayabas.
Balayan, Batangas.
Dingle, Iloilo.
San Antonio, Zambales.

There were published during the year Circular No. 124, "Notes on Horse Breeding in the Philippines," and Circular No. 94, "Poultry-Notes," revised.

Very few animals were purchased for the other branches of the Government, due doubtless to the still prevailing financial depression. Tables XXVII and XXVIII show the purchase (including the animals bought from the U. S.) and sale transactions of the Division.

TABLE XXVII.—*Sales of Bureau animals.*

	Cattle and carabaos		Swine		Goats		Sheep	
	No.	Price	No.	Price	No.	Price	No.	Price
Alabang Stock Farm	4	₱318.00	267	₱5,734.00	16	₱105.00	4	₱39.00
La Carlota Experiment Station	23	1,558.50	3	90.00	1	5.00	6	30.00
Cebu Breeding Station	----	----------	29	681.00	----	----------	----	----------
Batangas Breeding Station	2	225.00	9	92.00	----	----------	----	----------
Dingle Poultry-Swine Station	----	----------	5	74.00	----	----------	----	----------
Balayan Poultry-Swine Station	----	----------	10	62.00	----	----------	----	----------
Naic Poultry-Swine Station	1	160.00	----	----------	----	----------	----	----------
Tiaong Poultry-Swine Station	----	----------	3	45.00	----	----------	----	----------
Oriental Negros Breeding Station	----	----------	----	----------	----	----------	----	----------
Other Stations, etc	1	200.00	49	6,812.34	9	74.00	----	----------
Miscellaneous (see below)	----	----------	----	----------	----	----------	----	----------
Total	31	2,461.50	375	13,590.34	26	184.00	10	69.00

TABLE XXVII.—*Sales of Bureau animals*—Continued.

	Poultry		Eggs		Total	
	No.	Price	No.	Price	No.	Price
Alabang Stock Farm	688	₱1,728.00	15,722	₱2,968.52	16,701	₱10,892.52
La Carlota Experiment Station	48	164.42	863	184.31	944	2,032.23
Cebu Breeding Station	103	288.50	2,025	316.16	2,157	1,285.66
Batangas Breeding Station	17	25.25	354	44.75	362	387.00
Dingle Poultry-Swine Station	8	19.00	198	22.26	211	115.26
Balayan Poultry-Swine Station	18	23.20	264	14.40	292	99.60
Naic Poultry-Swine Station					1	160.00
Tiaong Poultry-Swine Station	70	155.00	162	6.75	235	206.75
Oriental Negros Breeding Station	37	105.00	648	61.96	685	166.96
Other Stations, etc	199	463.65	407	51.68	665	7,601.67
Miscellaneous (see below)						1,553.75
Total	1,188	2,972.02	20,643	3,670.79	22,273	24,501.40

Other animals:	
Pandacan, 25 Guinea pigs	₱100
Pandacan, 5 rabbits	35
	135
Crates:	
Alabang, 227	309.50
Cebu, 2	6.50
	316.00
Boxes:	
Alabang, 1,110	111.00
Cebu, 29	2.90
	113.90
Feeds:	
Alabang	16.90
Batangas	1.00
Cebu	99.60
La Carlota	494.35
Balayan	1.00
San Antonio	127.00
Dingle	37.00
	776.85
Horse fees:	
Batangas	212.00

TABLE XXVIII.—*Livestock purchased for the Bureau of Agriculture and other branches of the Government*

Disposition	Horses		Carabaos		Cattle		Swine		Poultry		Total
	No.	Purchase price	No.	Purchase price	No.	Purchase price	No.	Purchase price	No.	Purchase price	Purchase price
		Pesos		*Pesos*		*Pesos*		*Pesos*		*Pesos*	*Pesos*
Animal Husbandry Division	6	11,000.00			3	2,520.00	98	22,535.45	52	1,954.70	38,010.15
Veterinary Division			31	2,550.00	67	3,279.00					5,829.00
Administrative Division	3	1,150.00									1,150.00
Plant Industry Division			2	335.00							335.00
Philippine General Hospital	1	200.00									200.00
Philippine Constabulary	1	250.00									250.00
Balañga, Bataan					1	210.00					210.00
Total	11	12,600.00	33	2,885.00	71	6,009.00	98	22,535.45	52	1,954.70	45,984.15

NOTE.—The livestock purchased from the United States, as mentioned on page 3 of this report, is included in this tabulation.

Several inspection trips were made by the chief of the division and other employees of the central office to the various stock farms and stations during the year.

ALABANG STOCK FARM

About the middle and towards the close of the year hog cholera, surra, rinderpest, and foot-and-mouth disease were common around the neighborhood, but none of these diseases entered the farm because of the precautions taken against any possible contamination. Strict quarantine was observed as soon as the outbreak of any disease in the neighborhood became known. The public breeding work was also temporarily suspended, while all the station carabaos, cattle, and swine were immunized against rinderpest and hog cholera, respectively, by veterinarians from the central office.

Cross-breeding experiments were also started at Alabang during the year with different types of sheep, goats, cattle, and chickens for the purpose of studying the effects of certain mixtures of blood. Of course these experiments will have to be carried on for a number of years before any conclusion can be drawn.

Feeds.—The station produced all the forage needed and also the following grains for feed:

48,281 ears of corn
1,938 ears of corn (for seed).
800 kilos of corn pods.
17 sacks of poor ears of corn.
60 kilos of sorghum seeds.
1,841 kilos of palay.

Horses.—The horses were all in good condition in spite of the dry condition of the pastures during the first and second quarters of the year and the forced confinement of all the mares and their young in a small pasture during the beginning of the third quarter till the end of the year due to the presence of the surra disease at the Bureau of Science site, just adjacent to the farm. During their confinement they were given mixed feeds and different kinds of forage.

During the year three stallions—one hackney, one thoroughbred, and one jack—were received at the farm for upbreeding purposes.

HORSES

On hand last year	17
Births during the year	3
Received during the year	3
Transfers during the year	1
Deaths during the year	1
On hand at the end of the year	21

Cattle.—The work bullocks were all in good condition throughout the year. They were not affected by the dry weather for

they were given mixed feeds and forage when they were doing hard work. The Indian cattle also did well. None of them took any disease in spite of the presence of certain diseases among the cattle near their pasture.

One Ayrshire bull was received at this station during the month of August. This bull was crossed with young Indian heifers and cows that had newly calved. The main object in crossing these two breeds of cattle was to obtain offspring which would inherit the milking capacity of the breed of the male parent and the adaptability of the female parent to these Islands.

Some of the Indian cows may be considered as good milch cows as compared with the native cows.

CATTLE

On hand last year	34
Births during the year	2
Received during the year	3
Sales during the year	4
On hand at end of the year	35

The carabaos and cattle belonging to the Veterinary Division, which are under the supervision of this station, were also in good condition.

Goats.—The improvement of the small herd of goats in this farm was very remarkable. Many mestizos were raised this year and most of the females have dropped their kids already. Several Indian grade males and females were sold or transferred to other stations for breeding purposes.

Practically all the offspring were black in color and not brown. This shows that the male parent has stronger blood than the female parents.

Maltese goats, property numbers 586 and 537, commencing a week or so after they had their kids had to milked often lest their udders become so big that they could hardly walk. The amount of milk obtained in a day ranged from one to two liters each. This fact is very significant when we consider that the amount of milk usually given by one female goat in one milking day is on the general average only 600 cubic centimeters.

Pneumonia and mamitis were the two diseases observed during the year.

GOATS

On hand last year	43	
Births during the year	37	
Sales during the year	16	₱105.00
Transfers during the year	5	102.00
Deaths during the year	6	
On hand at the end of the year	53	
Raised to maturity	9	90.00

Indian Nellore Cattle at Alabang Stock Farm, Rizal, belonging to the Department of Agriculture and Natural Resources as per Act No. 2758

(*a*) A group of pure-bred Berkshire sows taking noon meal under madre de cacao trees in Alabang Stock Farm.

(*b*) A portable chicken house with Cantonese hen rearing chicks of several American breeds. Alabang Stock Farm, Rizal

Sheep.—At present the station has Mestizo Lincoln-Native and pure Indian breed sheep, and both are in good condition. Experimental cross breeding between the two types was started during the year.

When one to two weeks old lambs are docked and castrated. Both docking and castration can be done at the same time.

SHEEP

On hand last year	18	
Births during the year	15	
Received during the year	1	
Sales during the year	4	
Deaths during the year	2	
On hand at the end of the year	28	
Raised to maturity	6	₱120.00

Swine.—The Poland China pigs which were imported—for the first time—in November, 1920, seem to adapt themselves to Philippine conditions. Of course this was their first year, and further observations on and a closer study of this breed of swine will be made to learn their value in this country.

Another work on swine initiated this year was the castration of runted pigs. Runts were castrated and then sold for meat purposes. This was done with all the breeds for a comparative study as to how the different breeds would respond to the treatment.

SWINE

	Berk.	J. D.	York.	P. C.	Grade	Total	Price
On hand last year	111	58	13	29	3	214	
Births during the year	261	50	20	89	12	432	
Received during the year	103	0	0	0	0	103	
Sales during the year	126	54	20	66	1	267	₱5,734.00
Transfers during the year	30	1	0	5	0	36	7,130.00
Deaths during the year	59	17	3	8	3	90	
On hand end of the year	260	36	10	39	11	356	
Raised to maturity	16	8	4	1	0	29	2,900.00

NOTE.—Berk. stands for Berkshire, D. J. for Duroc-Jersey, York for Yorshire, and P. C. for Poland China.

Poultry.—As already indicated above, a number of poultry experiments in cross-breeding were started during the year.

Unfavorable weather conditions interfered very much with the poultry work at the station this year. The first part of the year was dry. The fowls could pick up but little fresh green grass in the yard. Young chickens were given sprouted corn and rice and the matured ones finely cut forage. The second semester, on the other hand, was so humid that the chicks suffered mostly from cold.

Natural and artificial incubation, were practiced as in previous years. Trap nesting was strictly followed to obtain an accurate record for individual hens and to show which were the unproductive hens to cull out.

These fowls were received at the station during the year:

Toulouse geese, 4 males and 10 females.
Embden geese, 4 males and 10 females.
Bronze turkeys, 4 males and 10 females.

Besides these, the Director of Agriculture donated to the Bureau 4 male and 10 female grade bronze turkeys.

Only large, clean, smooth, and well shaped eggs were used for hatching. Of these 15,722 were sold to the public and 5,612 hatched at the station. The undesirable eggs were fed to the little chicks. At the end of the year there were 597 matured birds at the station.

Diseases.—The most prevalent diseases were chicken pox, diarrhea, catarrh, eversion of the oviduct, and these kept the "hospital" quite busy during the year.

LA CARLOTA EXPERIMENT STATION

Administration.—The main activities at this station in 1921 consisted of public breeding with horses and pigs; production of poultry and eggs, young pigs, goats and sheep to be sold to the public at reasonable prices. Cattle raising—Indian and native stocks—-was the main project, however. Young cattle, pure or mestizo, were also sold to the public principally for breeding purposes. Practically all the feed used, both grain and green forage, was raised at the station, which also has fairly good pasturage.

Condition of animals.—At the end of the year, the animals were in good condition, although at one time of the year, the cattle and carabaos were affected by rinderpest, which cost the station a loss of about 12 per cent despite strict quarantine measures that were administered during the epidemic. Other losses of animals, including poultry, were due to other diseases. Ticks were practically got rid of by dippings. A dipping tank was constructed for this purpose.

Public breeding.—The breeding records at this station show lower figures this year than in 1920, because of the acute monetary depression.

Dipping Native Carabaos at La Carlota Experiment Station, Occidental Negros

(*a*) Indian Grade Cattle—crosses between pure-bred Indian Sires and Grade and Native Cows at La Carlota Experiment Station, Occidental Negros

(*b*) Mestizo Kentucky saddle stallion of the Bureau of Agriculture at San Antonio, Zambales. It has already rendered 60 services in Naic, Cavite

HORSES AND MULES

On hand at the beginning of the year	5
Died during the year	1
On hand at the end of the year	4

CATTLE

On hand at the beginning of the year	336
Born during the year	64
Sold during the year	22
Died during the year	76
Transferred to other stations	2
On hand at the end of the year	300

CARABAOS

On hand at the beginning of the year	49
Born during the year	6
Died during the year	18
Sold during the year	1
Transferred to other stations	2
On hand at the end of the year	34

GOATS

On hand at the beginning of the year	11
Born during the year	9
Received from other stations	3
Sold during the year	1
Died during the year	10
On hand at the end of the year	12

SHEEP

On hand at the beginning of the year	23
Born during the year	17
Sold during the year	6
Died during the year	5
On hand at the end of the year	29

SWINE

On hand at the beginning of the year	7
Born during the year	9
Received from other stations	5
Sold during the year	3
Died during the year	6
On hand at the end of the year	12

POULTRY

On hand at the beginning of the year	76
Raised to higher class	25

Sold during the year (48) grown up	10
Died during the year	22
On hand at the end of the year	69
Number of eggs laid during the year	2,633

CEBU BREEDING STATION

During the year, 1,750 visitors from the different parts of the Visayan Islands and from Mindanao and Sulu signed the visitors' book. They were greatly interested in the operations of the station.

Swine.—The hogs at the station were of the Berkshire and the Duroc Jersey breeds, and the former particularly did well.

SWINE

On hand at the beginning of the year	41
Born during the year	38
Received from other station	2
Sold during the year	29
Died during the year	10
On hand at the end of the year	42

Poultry.—With the exception of the Black Minorca, which does not seem to be adapted to local conditions, the various breeds of chickens, particularly the Cantonese, kept in good condition.

POULTRY

On hand at the beginning of the year	132
Raised to higher class	158
Sold during the year	103
Died during the year	52
On hand at the end of the year	135
Number of eggs laid during the year	3,893

Public breeding.—There were four stallions and eleven boars at the station for public breeding work. One of the horses, however, became useless on account of old age, while one of the boars was sick most of the time. The three stallions rendered 48 services in all, and the 10 boars 161, during the year. Comparatively speaking the horses rendered 60 per cent more service last year than in 1920, but there was a decrease of 51.5 per cent in the swine breeding. This fact is doubtless attributable to a great extent at least to the financial crisis prevalent during 1921, which made it more difficult for the people to bring their sows to the station on account of the expense for transportation.

This was not the case with the horse breeding because the mares could be at least made to walk to and from the station.

Feeds and feeding.—Excepting small quantities of mixed feeds supplied by the Alabang Stock Farm and some copra meal purchased from the local market, the station produced its own feeds.

BATANGAS BREEDING STATION

Swine.—The Berkshires find more acceptance among the people in the province than the Duroc Jerseys.

Poultry.—The Rhode Island Reds, the Shanghai Reds, and the Cantonese chickens are found more adaptable to the climatic conditions prevailing in the province than the other imported breeds.

Public breeding.—Great interest is shown by the people in upgrading the native horses as judged from the number of services rendered by the public breeding sires and the number of half breeds now found in the province. Formerly, there were in Batangas, Balayan, and Lipa, 10 stallions, but only 5 remained at the close of the year with 289 services rendered and 132 offspring to their credit and 7 boars with 186 services and 614 offsprings.

Feeds and feeding.—Concentrated feeds for the horses, pigs, and chickens at the Lipa, Balayan, and Batangas Stations were furnished by the Alabang Stock Farm, while green feeds, such as guinea grass, corn fodder, and cassava were raised locally.

ORIENTAL NEGROS BREEDING STATION

During the year, three grooms and two laborers paid by the Province were employed at the station. The laborers are working at Dumaguete poultry-swine station.

The most important projects in this province are horse, cattle, swine, and poultry breeding. There were at the station 3 stallions, which rendered 55 services, 3 Indian Bulls with 124 services, and 3 Berkshire and Poland China boars with 64 services.

The number of animals of the Bureau of Agriculture is as follows:

3 Stallions.
3 Indian Bulls.
3 Berkshire pigs (2 boars and 1 sow).
3 Poland China pigs (2 sows and 1 boar).
1 Grade Indian male goat.
1 Barred Plymouth Rock hen.

5 White Leghorn chickens (4 hens and 1 rooster).
2 Rhode Island Red chickens (1 hen and 1 rooster).
3 Shanghai Red chickens (2 hens and 1 rooster).
11 Cantonese chickens (10 hens and 1 rooster).

Number of chickens raised at the station belonging to the Province of Oriental Negros:

4 White Leghorn chickens (3 roosters and 1 hen).
6 Rhode Island Red chickens (2 roosters and 4 hens).
14 Shanghai Red chickens (7 roosters and 7 hens).
39 Cantonese chickens (13 roosters and 26 hens).
6 Native hens.
45 Small chicks, below two months old.

There were sold during the year 37 chickens and 648 eggs. The eggs that were not sold were hatched at the station.

Interested parties not able to buy eggs or chickens were either allowed to bring their hens to the station and have them bred to the roosters or allowed to borrow the roosters and take them to their homes for breeding purposes.

The people were also greatly interested in pig raising.

PANDACAN CHICKEN HOUSE

To introduce a breed of chicken of uniform color and more adapted to the climate in this country than the Rhode Island Reds and larger than the Cantonese, cross breeding between the two breeds was begun at this station during the year. The results obtained so far do not justify the making of a definite conclusion.

Public breeding work is also going on at this station. At the end of the year there were two stallions and one Berkshire boar ready for service.

This station also serves as a "Transfer Station." Animals destined for breeding purposes throughout the Island are sometimes quartered at this station before they are sent out.

At the end of the year, there were at the station:

2 Stallions.
1 Mare.
10 Goats.
1 Rhode Island Red cock.
4 Cantonese cocks.
48 Cantonese hens.

Chickens below five months old are not included in this list.

POULTRY-SWINE STATIONS

There were ten coöperative poultry-swine stations and four maintained by the Bureau. Some of the coöperative stations

were closed during the year due to the shortage of funds for their proper maintenance. The location of and the results obtained in each station are given below:

TABLE XXIX

Names of stations	Animals loaned by Bureau						Animals raised				Bureau animals December, 1921					Remarks
	Indian bull	Carabaos	Work bullocks	Pigs	Chickens	Ducks	Carabaos	Pigs	Chickens	Ducks	Carabaos	Work bullocks	Pigs	Chickens	Ducks	
1. Naic	----	----	1	4	50	6	----	----	----	----	----	----	----	----	----	Closed Jan. 1921.
2. Dingle	3	1	1	9	36	1	1	23	30	1	2	1	10	29	2	Bureau station.
3. Balayan	----	----	----	7	53	----	----	18	----	----	----	----	7	39	----	Bureau station.
4. S. Antonio	----	1	----	2	32	1	----	13	72	----	1	----	2	32	1	Formerly municipality but transferred as Bureau station.
5. Tiaong	----	----	----	3	17	----	----	12	28	----	----	----	15	45	----	Bureau station.
6. Sta. Barbara	----	1	----	4	32	2	----	30	97	17	1	----	1	24	2	Animals raised and sales belong to province.
7. Ilagan	----	----	----	2	5	----	----	----	40	----	----	----	2	5	----	Station opened in Aug., 1921.
8. Los Baños	----	----	----	4	1	----	----	31	36	----	----	----	4	1	----	Offspring belong to College.
9. Amulung	----	----	----	3	27	----	----	7	82	----	----	----	3	27	----	Offspring belong to Cagayan.
10. Vigan	----	----	----	3	12	2	----	3	50	5	----	----	3	6	3	Offspring belong to Vigan.
11. Palo	----	----	----	3	43	----	----	7	268	----	----	----	1	----	----	Bureau animals sold.
12. Bilar	----	1	----	2	46	----	----	----	----	----	----	----	----	----	----	Station closed.
13. S. Jose	----	----	----	3	14	----	----	----	----	----	----	----	3	14	----	Opened Oct. Antique, 1921.
14. Bayombong	----	----	----	6	73	5	----	4	150	----	----	----	2	----	----	Offspring belong to N. Vizcaya.

NOTE.—This report excludes sales.

BONGABON STOCK FARM

The Bongabon Stock Farm belongs to the Department of Agriculture and Natural Resources (Act No. 2758). The Bureau of Agriculture has a small herd of goats at this station. During the year six were born, three were sold, and four died, and at the end of the year there were ten goats at the station.

RECOMMENDATIONS

1. That the Philippine Legislature provide liberal funds for the purchase of animals and poultry, for the establishment of more breeding stations and stock farms and for the proper compensation of personnel to take charge of the work.

2. That a law should be enacted obliging the provincial board in every province to set aside a certain sum of money as an

aid to the Insular Government for the establishment and maintenance of a breeding station, stock farm or poultry-swine station or a combination of either two of the three, and also a piece of land suitable for the purpose.

3. That positions for two supervising animal husbandman be created to ensure proper supervision of the animal husbandry stations in the Islands.

4. That a pensionado having technical training and long experience in animal husbandry in the Government service be appointed to travel in Australia, Argentine, United States, and Europe to study the different phases of the livestock industry.

5. That a stock farm be established in Mindanao, preferably Bukidnon, for experimental and demonstration purposes.

DIVISION OF PUBLICATIONS

ACTIVITIES

(*a*) Publication of:
- The Philippine Agricultural Review (quarterly).
- The Philippine Farmer (monthly).
- El Agricultor Filipino (monthly).
- Bulletins, Circulars, etc.

(*b*) Translation.

(*c*) Administration of the Bureau library.

(*d*) Multigraphing and photographic work.

PERSONNEL

At the beginning of the year there were 18 employees—9 permanent and 9 temporary. By December 31, 1921, five of the temporary employees had been dropped.

The Philippine Agricultural Review.—At the beginning of the year there were almost 2,000 names on the free mailing list of the REVIEW. To economize this number was reduced to 583 and the number of printed copies ordered was reduced from 2,000 to 1,200.

The Philippine Farmer.—Due to the shortage of money for printing purposes, only six number of *The Philippine Farmer* and four of *El Agricultor Filipino* were published. However, some articles that had been prepared and translated for the subsequent numbers of these papers were furnished to the local and provincial dailies and weeklies and were duly published therein. The total number of *The Philippine Farmers* distributed was 27,036; of *El Agricultor Filipino*, 35,766.

Bulletins.—During the year, the following bulletins were published:

Bulletin No. 32. Plant Propagation and Fruit Culture in the Tropics (revised edition) by P. J. Wester, 2,000 copies. Sold at ₱1 or ₱1.40 postpaid each.
Bulletin No. 18. The Mango (revised edition) by P. J. Wester, 2,000 copies. Sold at ₱1 or ₱1.20 postpaid each.
Bulletin No. 37. Rice production in the Philippines by Jose S. Camus, 2,000 copies. Sold at ₱1 or ₱1.40 postpaid each.

Circulars and miscellaneous publications.—The following circulars were printed during the year:

Circular No. 119. Cultural Directions for Field Crops and Vegetables (English and Spanish).
Circular No. 120. The Cultivation and Uses of Roselle (English).
Circular No. 121. The Preservation of Tropical Fruits (English).
Circular No. 122. The Breadfruit (English).
Circular No. 123. The Preparation and Packing of Seed and Scions for Shipment in the Tropics (English and Spanish).
Circular No. 124. Notes on Horse Breeding in the Philippines (English and Spanish).
Circular No. 126. Locust Extermination (English and Spanish).
Circular No. 127. Napier Grass and Its Culture (English and Spanish).

The following articles of the Philippine Agricultural Review were also reprinted and are now distributed as miscellaneous publications:

"Notes on Adlay"
"Agusan: Its Natural Resources and Development"
"Cotabato: Its Natural Resources and Development"
"Davao: Its Natural Resources and Development"
"Sulu Archipelago: Its Natural Resources and Development"
"Zamboanga Province: Its Natural Resources and Development."

Publications distributed.—The total number of publications distributed during the year was 85,766 as against a total of 45,468 last year.

The following figures show in detail the distribution of publications:

	Copies.
Bulletin (English)	5,421
......do..... (Spanish)	6,613
Circular (English)	8,509
......do..... (Spanish)	2,549
Annual Report	2,146
Miscellaneous publications	1,445
Philippine Agricultural Review (including copies distributed to subscribers)	2,704
Philippine Farmer (English) (including copies distributed to subscribers)	27,036
Philippine Farmer (Spanish) (including copies distributed to subscribers)	35,343
Total	85,766

News items.—During the year a total of 455 news items were distributed as against 379 of last year. These consisted of crop reports and special articles intended for *The Philippine Farmer* but on account of the suspension of its publication, issued to the local and provincial papers.

Translation.—The translation comprised the following work:

Articles	No. of work orders	No. of pages
The Philippine Farmer (Jan.–June) (El Agricultor Filipino)	6	318
Twentieth Annual Report	1	106
News Items	185	455
Miscellaneous (Bulletins, circulars, budget, letters memoranda, legislative bills, contracts, etc.)	106	548
Total	298	1,427

LIBRARY

During the year 1921, the total number of publications received in the Library amounted to 5,270. Library information sheets giving a list of the publications newly received together with their principal contents were issued periodically and sent to the Directors and Division Chiefs. The number of readers and borrowers steadily increased during the year, reaching 2,268. The number of publications read and borrowed was 5,735.

Books and periodicals.—Fifty-two technical books were received. The Library also received regularly 258 different publications consisting of annual reports, bulletins, circulars, and general publications.

Binding and shelving.—Only about 6 volumes of those prepareu for binding were bound during the year, due to lack of funds.

Cuts.—Three hundred and forty-seven were handled.

The following figures summarize the work of the Library:

Publications received	5,270
Books received	52
Regularly received periodicals	258
Readers and borrowers	2,268
Publications read and barrowed	5,725
Publications accessioned and catalogued	655
Subjects and author cards made	722
Articles clipped	1,573
Publications indexed	740
Publications bound	6
Cuts handled	347

Photographic work.—During the year 1921, a total of 4,864 prints were made and 247 plates and 49 rolls of film developed.

Mimeograph, planotype and multigraph work.—During the period from January 1 to December 31, 1921, a total of 814,245 pages on a total of 1,241 works orders were printed on the mimeograph; 355,850 pages on 63 work orders in the multigraph; and 59,080 pages on 35 work orders in the planotype machines, making a grand total of 1,227,175 pages on 1,339 work orders.

RECOMMENDATIONS

In order that agricultural propaganda may be more effective, that such better methods of farming as are advocated by the Bureau of Agriculture may be adapted by the farmers, it is recommended that all such literature issued be translated into a number of the native dialects. And for this purpose more appropriation should be given for additional translators and printing purposes; and our bulletins and circulars should be written in very simple style so that they may be understood by the common farmers.

CONCLUSION

As in previous reports, many of the statistical tables such as detailed reports of the sale of animals, livestock purchases, crop production, breeding records, inspections, publications, fiber records, plant propagation records on rice, sugar, corn, tobacco, laboratory tests, maps, graphic charts, etc., are not incorporated herewith, in order to economize both the time to prepare them and space. They are, however, available in the several divisions of the Bureau and will be furnished when detailed information on any of those subjects is required.

Respectfully submitted.

ADN. HERNANDEZ,
Director of Agriculture.

To the Honorable
the SECRETARY OF AGRICULTURE and
NATURAL RESOURCES,
Manila, P. I.